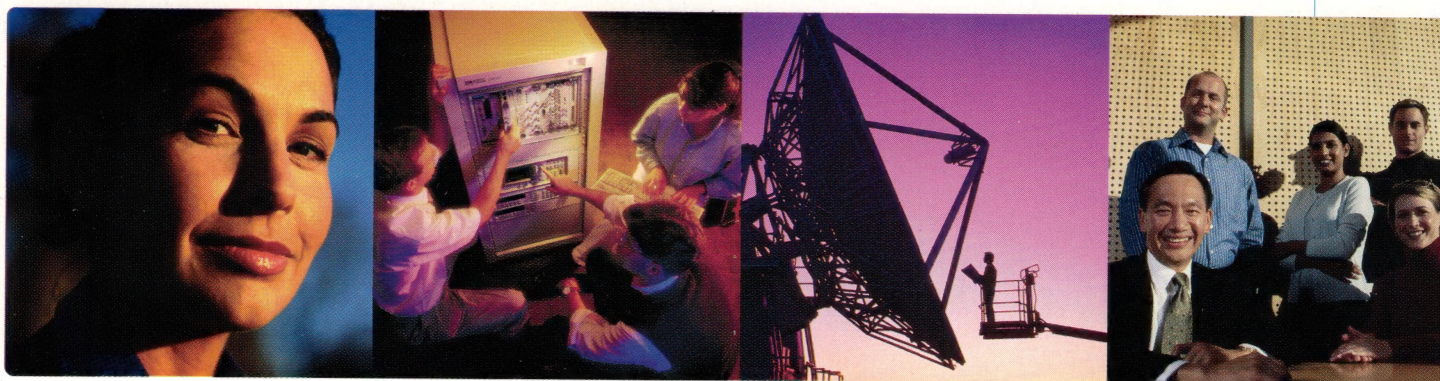


2002-2003 VXIbus Products Catalog



Agilent Technologies



Welcome to Agilent Technologies and VXI!

Dear Agilent Customer:

If it's your job to produce quality products and get them to market quickly, you need test systems you can count on—test systems that deliver reliable and repeatable measurements from design verification to manufacturing. A test platform based on the VXIbus standard meets your testing needs for fast system development, fast time-to-volume, fast test throughput, and low total cost-of-ownership.

Agilent Technologies is ready to help test engineers who are using, or considering, VXI-based systems and solutions. We look forward to working together to further your success through flexible, long-lived test systems. Please see our new products on pages 2-6, which show our continuing commitment to VXI.

Again, welcome to the Agilent 2002-2003 VXI Products Catalog—the world's largest selection of VXI components, products, and services from a single manufacturer.

Please visit our website at **www.agilent.com/find/vxi** to stay up-to-date on new products, applications, and services.

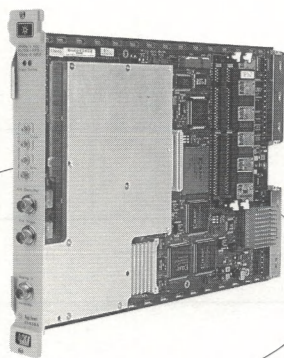


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New Products



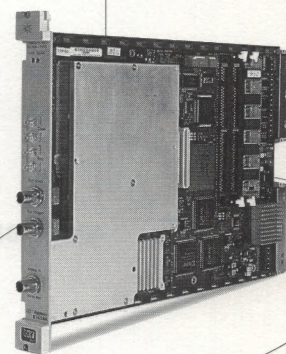
Agilent E1439A

95 MSa/second Digitizer with 70 MHz IF Input

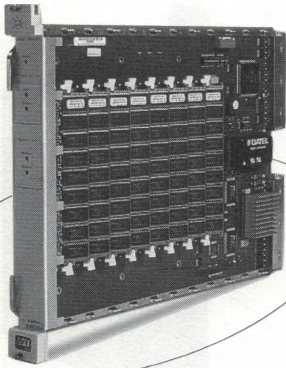
This new A/D converter provides you high-resolution digitizing at a fast sample rate for RF signal acquisition and analysis. You can connect your signal either to the baseband or 70 MHz IF inputs, each with a 36 MHz bandwidth. Along with 12-bit resolution, -90 dBfs spurious free dynamic range and 95 MSa/sec digitizing, the E1439A features full input signal conditioning for its 70 MHz IF input, tunable digital filtering, a large signal capture memory, and high-speed data ports.

100 MSa/second Digitizer with DSP and Memory

The Agilent E1438A is ideal for application in signal acquisition and analysis, high-resolution ATE and radar testing. This single-channel 12-bit, 100 MSa/s digitizer has an alias-protected 40 MHz input bandwidth. It combines exceptional spurious-free dynamic range with alias-protected signal conditioning, center frequency tunable digital filtering, and a large signal capture memory.



Agilent E1438A



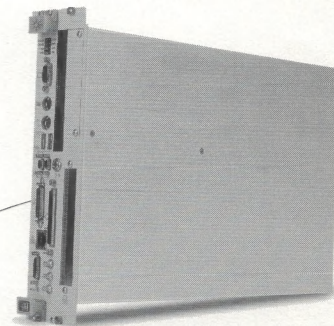
Agilent E9830A

Delay Memory Module

Adding delay memory to a COMINT system allows you to see signals from the beginning, ensuring first-bit or first-syllable copy of the energy of interest. In systems that perform signal monitoring, use the E9830A to give your DSP algorithms the time they need to detect signals of interest hidden in a digital data stream. When a "rare event" signal appears, the module can take a snapshot that saves the entire event for detailed post-processing. With the E9830A, you can go back in time to catch the most elusive signals—from the first bit. You can configure the E9830A Delay Memory module with up to 2048 MB of delay memory connected to the VXI local bus, and move data to and from delay memory as fast as 53 MB/sec.

VXI Pentium® PC

Agilent's newest 700 MHz Pentium III, 2-slot VXI embedded PC runs on Windows® operating systems. The Agilent E9851A can be embedded in various Agilent mainframes including the 13-slot E8400 series, the E1401B, or the E1421B.

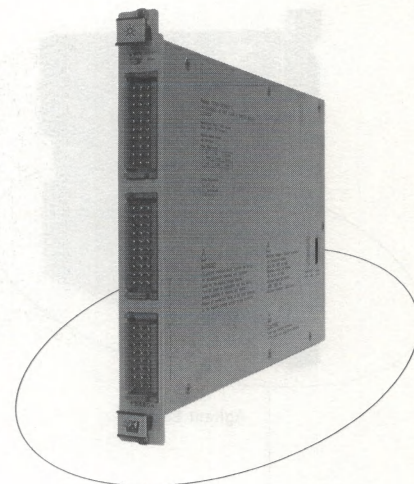


Agilent E9851A

New Products

High-Power General Purpose Switch

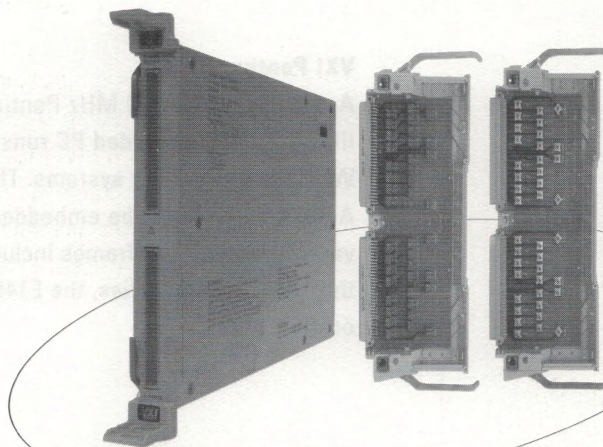
Switch up to 12 Amperes of dc or ac current at up to 150 VDC/300 VAC rms with the new E8480A. This switch module provides 40 channels of Form A (SPST) power switching for actuation and control requirements in your test systems.



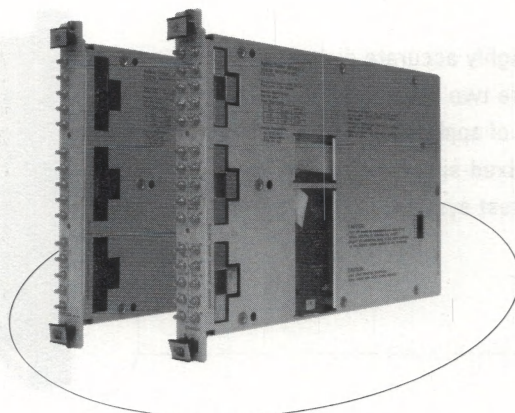
Agilent E8480A

Wideband 4x32 Matrix Switch

This new switch module gives you the versatility of a matrix topology while maintaining high signal integrity up to 70 MHz. The E8481A can be configured as a single 4x32 or dual 4x16 2-wire matrix. Connections can be made through screw terminals or SMB connectors.



Agilent E8481A



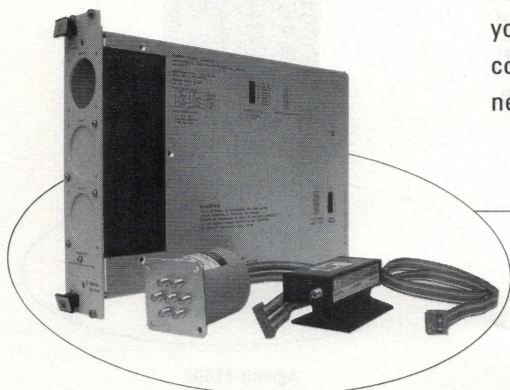
Agilent E8482A/B

3 GHz RF Multiplexer Switches

Connect high-frequency signals to your instruments with confidence through these new RF multiplexers. The E8482A/B provides either three or six 3 GHz 1x4 multiplexers on each module. The high isolation and low insertion loss of these switches allow you to maintain high signal integrity in your test system.

Microwave Switch/ Attenuator Driver

Control any combination of up to six high-performance microwave switches or step attenuators. The new E8483A is designed to allow you to easily control Agilent 1x4 and 1x6 microwave switches for signals up to 26.5 GHz, and Agilent step attenuators for signals up to 40 GHz. You can install up to three of the switches inside this module, or you can locate the devices being controlled outside the module and near to your DUT.

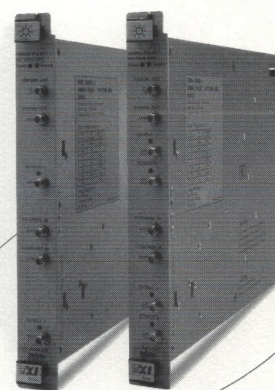


Agilent E8483A

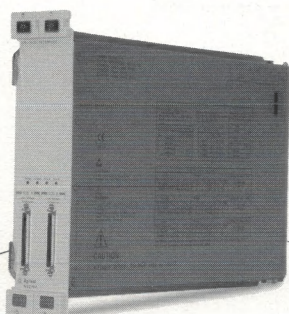
New Products

Pulse/Pattern Generators

These two new pulse/pattern generators offer highly accurate digital signals up to 165 MHz/330 MHz respectively, and feature two output channels. The E8311A and E8312A can be used for a wide variety of applications ranging from functional verification of high-speed digital or mixed-signal devices to clock generation for synchronization of an automated test system, to radar testing, serial bus testing, and flash memory testing.



Agilent E8311A/E8312A



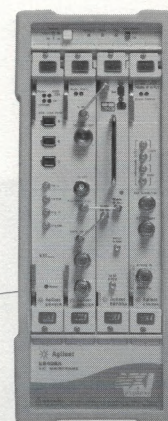
Agilent N2216A

VXI/SCSI Interface

You no longer need to accept gaps or missing samples in your high-speed transient digital data capture. With Agilent's new N2216A VXI/SCSI Interface, and using the VXI local bus, you can transfer data from VXI A/D modules to the N2216A's optional dual disk version at a real-time, sustained rate of more than 24 MB per second without losing a single byte of data!

Vector Signal Analyzer

Vector signal analyzers are now common tools in R&D of digital communications because they allow designers to uncover problems they couldn't see using traditional spectrum analyzers. The new Agilent 89600 VSA covers wideband signals up to 2.7 GHz with bandwidths up to 36 MHz (RF) or 39 MHz (baseband), opening up new applications, and an intuitive industry-standard user interface, and tight integration with PC-based design and analysis tools.



Agilent 89600

"Using VXI hardware has made the test more accurate and the development quicker—by probably 75 percent."

Agilent VXI user

Fast test system development for fast Time-to-Market

Test system developers choose VXI for its fast system integration, compact size, high throughput, and flexibility. You can use VXI products to build a variety of test systems from portable testers for field use and remote data acquisition applications to high-performance data acquisition and functional test systems. Agilent offers the single largest VXI product offering in the industry. From instruments to controllers to mainframes to complete turnkey systems, Agilent's VXI equipment enables users to develop systems that improve test quality and throughput with lower operating and maintenance costs.

High test throughput for fast Time-to-Volume

For demanding applications, the high-performance capability designed into the VXIbus standard allows you to create test systems that acquire and process data faster than is possible with conventional GPIB systems. The large card size and number of mainframe slots in C-size VXI can provide an effective and economical way to deliver systems with very large switch-point counts.

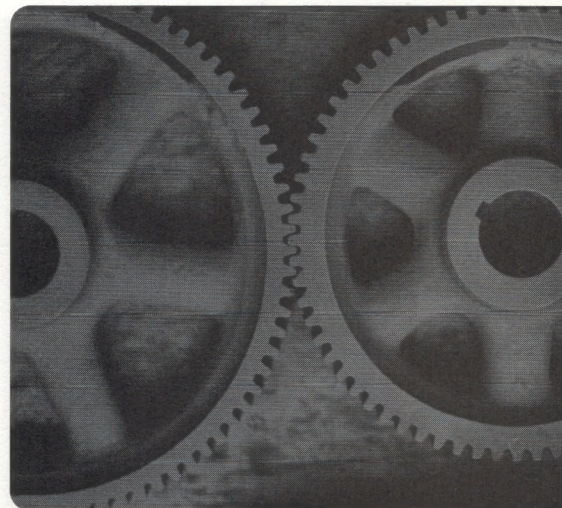
Open system environment

System developers benefit from a large choice of open test system components. Agilent and other

VXI vendors are providing an increasing number of standard off-the-shelf test system hardware and software products. VXI is an open standard environment in which you can specify the VXI *plug&play* framework you need based on your computer's operating system, and select the rest of your system components based on that framework. Having a large variety of products and vendors that work in an open standard environment reduces total life-cycle costs for the test systems on which you rely. This open standard environment also allows you to modify your test system more easily and quickly to meet changing needs through the years. VXI provides a low-risk means of maximizing the return on your test system assets.

Core system elements

Mainframes: The Agilent E8400 series offers a selection of 13-slot, C-size mainframes that allow you to choose the right combination of power, monitoring, and price for your application. The Agilent E8408A 4-slot, C-size mainframe is ideal for low-cost, compact data acquisition and functional test applications. The Agilent E1300 9-slot, B-Size mainframes are well suited for smaller functional test systems with a variety of instruments and lower channel counts.



Computers and interfaces: For test systems using external computer control, you can use either FireWire (IEEE-1394) or GPIB (IEEE-488) interfaces to control your VXI system. Agilent offers high performance embedded VXI PCs for applications that require either minimum test system space consumption or the ultimate in I/O performance between computer and instruments. Agilent's LAN/GPIB gateway provides low-cost access to GPIB instruments via your LAN.

"Without question, software development time was cut to a tenth (using Agilent VEE). Plus, software execution can be easily tracked for easy debug." *Agilent VEE user*

Instrumentation and switching

Agilent offers a wide range of VXI instrumentation products in over 20 categories, from analog sources to digitizers to multimeters to signal analyzers. In several areas, Agilent offers a particularly rich set of choices including the following:

Multifunction Scanning A/Ds:

Today's scanning A/Ds are fast, accurate, and provide both complete signal conditioning and high-level instrument functions. In its simplest form, a scanning A/D consists of a high-speed multiplexer, an A/D converter, and a system computer. Scanning A/Ds and multifunction modules economically automate the acquisition of electronic and physical data. The tightly integrated combination of scanning and A/D provide fast data acquisition rates. When you add in the high-performance on-board computing performance of a DSP engine, you gain the ability to analyze the measurement and create near-real-time control outputs in response to the measured data. When used with a compact 4-slot mainframe, multifunction modules create a complete low-cost, portable data acquisition system.

Switching: Agilent offers a wide range of multiplexer, matrix, and general purpose switch modules for a variety of signal levels and bandwidths. You can have confidence

in the quality of your signal connections from dc to RF to microwave. High-density switch cards allow you to pack hundreds of channels into a small space. Choices include reed, armature, and FET relays so you can optimize your switching performance for your signals. For example, by combining high-density multiplexers and a fast multimeter in a 4-slot mainframe, you can build a very economical system capable of measuring over 500 channels of data.

Digitizers: Agilent provides a variety of digitizers to capture your signals with the optimum combination of sampling rates, signal resolution, and bandwidths. You can digitize audio signals with high resolution and perform complex DSP analyses on-board to obtain meaningful results that support fast test throughput. Higher speed transients are easily measured with fast signal digitizers.

Instrument drivers

Agilent VXI products are designed to work in whatever software environment works best for you. *VXIplug&play* drivers allow you to use Agilent VXI hardware in software environments such as Microsoft®, Borland C/C++, Visual Basic, Agilent VEE, LabVIEW, and LabWindows. In 1987, a consortium led by Agilent and other major test and meas-

urement equipment companies introduced VXIbus as a new standard open architecture for modular instruments. Today, Agilent is the world's leading supplier of *VXIplug&play*-compatible products. Having pioneered open systems, Agilent is an expert at understanding the tremendous difference industry standards can make in test and measurement applications.

Agilent VEE

Agilent VEE is the premier graphical programming language. From its inception, Agilent VEE has delivered on its promise to dramatically decrease the test software development process. Agilent VEE's graphical development environment means shorter learning curves, faster creation of new applications, and dramatically reduced programming complexity. Agilent VEE is available for Microsoft Windows and HP-UX operating systems. Agilent VEE's support of *VXIplug&play* guarantees compatibility with a host of instrument drivers from many different vendors. Its open architecture is designed for easy integration with a variety of standard languages. It can incorporate routines from Visual Basic and Microsoft and Borland C/C++, so your existing code in these languages is preserved.

System expertise

Test system solutions:

Agilent's core competency

Our years of experience as one of the world's largest electronic design and manufacturing companies has taught us a few things about productive design and manufacturing test. We would like to be your test process specialist, helping you meet your needs and lowering the risks of test system development to your operation.

Agilent custom test systems

Agilent can work with you to design and implement test systems customized for your specific needs. Using Agilent hardware and software, and other vendors' equipment, we can create the optimum design for your test system. We use a well-defined development and implementation process that involves our experienced project managers and engineers, who work with your staff at all stages of the project life-cycle.

Agilent channel partners

Agilent maintains close working relationships with innovative software developers, system integrators, and complementary hardware vendors who can provide specific application expertise for your test system requirements. Through these strong alliances, we can help provide you with the best solutions possible for your test and data acquisition applications.

Agilent's commitment to standards

You have been telling the industry: "We want to get the same measurement answer even if we change the instrument." We are helping develop the solution to "different asset, same answer".

Interchangeable virtual instruments (IVI) is a proposed test and measurement instrument driver standard that builds on the *VXIplug&play* specifications. Designed to help test system developers, the proposed IVI specification can save engineering departments time and money by offering standardized software interfaces for common instrument classes. Those capabilities make it possible to re-use more of your existing software, and that reduces test system development time.

IVI's efforts will limit the existing wide variety of instrument drivers across the industry. Those drivers are sometimes difficult to learn and use, and some instruments even lack drivers. Users want a simple, consistent software interface between their PCs and their instruments. A uniform open driver standard can simplify instrument programming by:

- Minimizing the need to re-learn multiple interfaces when moving from one instrument to another,
- Enabling less software rework when replacing an instrument of the same class,
- Guaranteeing a minimum set of accessible functionality.

Early IVI Foundation specifications provide the first steps toward instrument interchangeability. However, ensuring the ability to switch instruments in deployed test systems without having to modify application software requires an additional standard layer beyond instrument drivers. An IVI Foundation subgroup is evaluating how to extend the standard to include such a layer that may be based on the IVI, measurement and stimulus subsystems (IVI-MSS).

VXI Solutions

03



Today, more and more devices are incorporating electronics to provide increasingly powerful functionality. This electronic content, and the subsystems in which it resides, are rapidly growing in complexity. To assure the performance, quality, and reliability of these devices, manufacturers are finding the need to employ a greater degree of functional testing of these devices in all stages of design and manufacturing. Functional testing using VXI is a fast, efficient, and economical way of doing this. Applications that benefit from VXI test systems include wireless handsets, wireless and wireline infrastructure equipment, automotive electronics, electronic control systems, and military/aerospace avionics and control modules. VXI is used for functional testing of these devices and many others in design verification, manufacturing, and maintenance.

VXI provides a foundation for quickly creating test systems from off-the-shelf, reliable components. VXI supports your requirements to implement test systems that meet your time-to-market and time-to-volume needs.

VXI's high-performance backplane and tightly integrated modules allow it to perform tests much

faster than conventional rack-and-stack instruments, making it ideal for high-volume manufacturing. VXI's form factor also makes it convenient for building custom fixtures for connections to the device under test.

VXI systems are easily modified and extended so you can efficiently deliver test systems that meet changing requirements as your device design progresses and as your product is modified and improved in manufacturing. As you need to create new test systems, you can efficiently leverage your previous knowledge and test system designs to meet your new testing requirements. By their modular, extensible nature, VXI systems can be configured in various ways for testing different types of electronic devices and for different parts of your manufacturing processes.

Test engineers are continually being challenged to improve their return on assets by reducing the cost of test, improving test throughput, and reducing the space consumed by test systems on the manufacturing floor. VXI reduces the cost of test development, operation, maintenance, support and modification. VXI is a great way for you to minimize your total life-cycle cost-of-ownership.

E5022B Hard Disk Drive Read/Write Test System

The E5022B is Agilent Technologies' revolutionary hard disk read/write test system designed for evaluating advanced MR (Magneto Resistive) and GMR (Giant Magneto-Resistive) heads and head/media interfaces. The Agilent E5022B combines measurement electronics with a spin stand to enable R&D and production engineers to focus on critical measurements, rather than their test systems. Modular system design allows easy upgrades.

The Agilent E5022B test system contains electronic test modules specifically designed for the demands of disk drive/head testing, as well as a customized mechanical spin stand. These are controlled by firmware and software to provide a fully integrated test system aimed not only at today's requirements, but tomorrow's.

Features

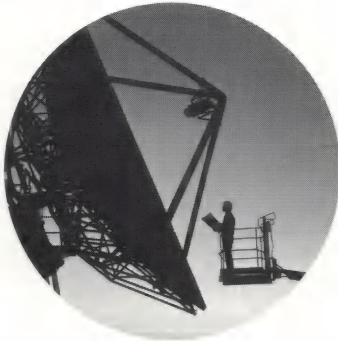
- High accuracy
- High repeatability
- High test throughput
- High bandwidth
- High bit-rate data patterns
- Choice of floor- or table-supported spin stand
- Built-in system calibration
- High flexibility for new measurement needs and functions
- Documented dynamic link library of function calls



Agilent E5022B

VXI Solutions

03



Agilent Technologies' VXI helps you develop and test next-generation solutions in wireless, wireline, Internet, voice, and digital communications. Agilent's VXI products and test systems easily integrate with leading-edge GPIB instruments to create a comprehensive array of test and measurement solutions. Agilent's exceptionally broad range of innovative VXI and GPIB test products and integrated solutions support everything from mobile appliances to base stations to network equipment.

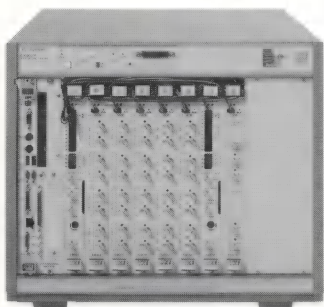
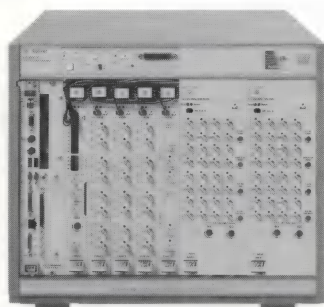
Agilent VXI products and systems help you build and provide increased bandwidth worldwide to meet performance and capacity demands. These products are used in R&D, production, installation, and maintenance testing of SONET, SDH, DWDM, and ATM telecommunications network equipment. These products provide a range of functional measurements from dc to 10 Gb/s, performing accurate and reliable performance measurements to the relevant ITU-T Network Equipment standards.

Agilent VXI products help mobile phone manufacturers around the world meet the testing requirements of their demanding and dynamic business. Agilent VXI equipment is used for switching, basic measurements, and test system control along with other dedicated GPIB wireless measurement instruments. Test engineers utilize the off-the-shelf open standard VXI technology to quickly create test systems that support their needs for fast system integration, short time-to-market, and rapid ramp-up to volume.

VXI's modular architecture supports the needs of telecommunications equipment manufacturers to implement a flexible approach to test systems that can be modified and upgraded as new devices are introduced and as shifts occur in your product line mix. VXI's compact size allows you to obtain the testing capability you need in a small footprint on your manufacturing floor, reducing total manufacturing space required per unit shipped.

SpectralBER - The expandable DWDM test solution to 10 Gb/s

SpectralBER is a family of products providing a flexible, expandable SONET/SDH test solution from 155 Mb/s to 10 Gb/s. Measurements include functional testing of optical add/drop multiplexers, optical translators, transponders and multi-channel systems. Key DWDM tests include BER performance, concatenated payloads to simulate live traffic, and path trace to identify individual channels for continuity tests. SONET/SDH overhead performance monitoring and analysis is also provided, together with error injection and alarm monitoring.



Agilent SpectralBER

Aimed at manufacturing test, its modular structure allows you to test one or multiple optical channels, maximizing your DWDM test throughput with a low cost-of-test per channel. SpectralBER is expandable to meet future needs. It's scaleable so one DWDM testing approach fits a mix of different channel counts and line rates of your products. You can tailor transmitter and receiver modules to suit your test requirements for a truly cost-effective solution.

SpectralBER packs measurement capability into a small footprint. Because SpectralBER uses the open VXI architecture, your own VXI modules can be an integral part of the test system, minimizing test racks and simplifying system integration.

Performance summary

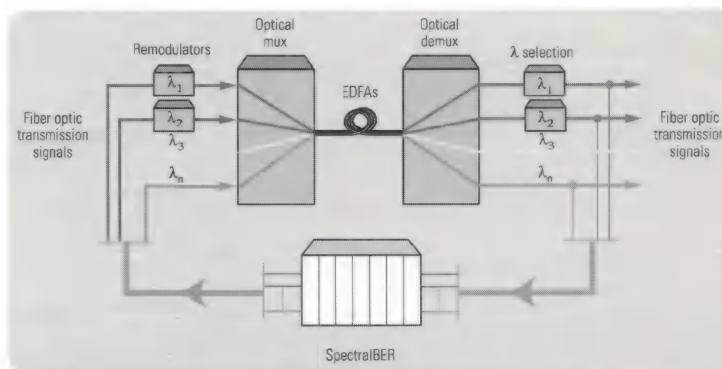
- 1310 nm, 1550 nm or ITU-T wavelengths
- Bit; B1, B2 and J0 byte monitoring and analysis
- Long-reach or short-reach optics for transmitter and receiver
- BER system performance using concatenated payloads
- Error injection and detection
- Alarm generation and detection

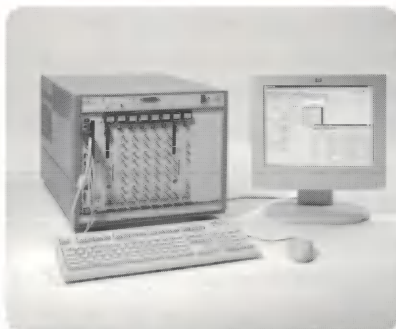
SpectralBER Multi-rate:

- 155 Mb/s to 2.5 Gb/s interfaces
- Concatenated payloads
- Basic functionality optimized for multi-channel test applications
- Up to 20 ports per mainframe

SpectralBER 10G:

- 10 Gb/s interfaces
- Concatenated and channelized payloads
- Higher functionality for single or multi-channel test applications
- Up to 4 ports per mainframe





Agilent 81250

Parallel Bit Error Ratio Tester: Agilent 81250 Series

The Agilent 81250 ParBERT is a modular parallel bit-error-ratio solution ideal for high-speed digital component testing. The system generates pseudo random word sequences (PRWS) and standard PRBS on parallel lines. You can analyze bit-error ratios with user-defined data, PRBS or mixed data. The scaleable solution lets you configure a system to fit your applications needs. A system consists of a mainframe, clock module, data module(s), and front ends.

Features:

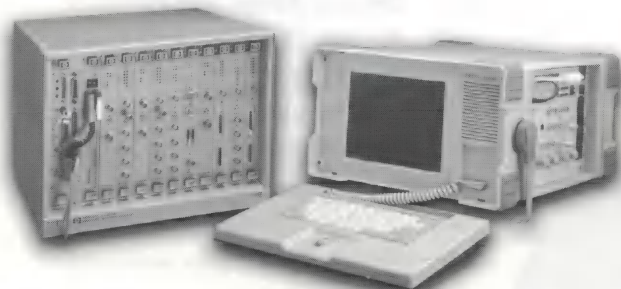
- Generate pseudo-random-word-sequences (PRWS) and standard PRBS $2^{31}-1$
- Analyze bit-error ratios with user-defined data, PRBS or mixed data from parallel ports
- Up to 64 channels
- Up to 2.67 Gbit/s
- Mix of generator/analyzer channels and speed classes
- Generate and analyze single-ended, low voltage and differential signals
- Data generation and analysis with sequencing and looping
- Auto synchronization
- Intuitive Windows NT®-based user software
- Synchronize system with external clock
- Independent programmable control of voltage levels and timing delays for each generator or analyzer channel
- Interrupt-free change of analyzer delay

Broadband Series Test Systems

On the leading edge of ATM technology, the Agilent broadband series test system (BSTS) is world-renowned for its breadth of capabilities in ATM switch development, high-speed access devices, carrier networks, and ATM services. The industry-standard BSTS is helping equipment developers and service providers lead the FastPacket revolution and reshape the networks of tomorrow. With the BSTS, you can quickly create complex test scenarios and automate repetitive testing. Just like the network equipment that you test, the BSTS conforms to the latest national and international standards.

With its attention to measurement accuracy, and its compliance with accepted test methodologies, the BSTS has become the industry-standard broadband test system. Equipment vendors and carriers rely on the BSTS for the following applications:

- Functional stimulus-response testing
- System regression testing
- Conformance and interoperability verification
- Performance benchmarking
- Switch evaluation
- Rapid fault-finding



Agilent Broadband
Series Test System

The BSTS provides you with testing solutions for both ATM and IP:

- Switch-router testing
- 3G wireless
- ATM traffic management
- ATM signaling

The BSTS is a modular, UNIX®-based test platform. It is available in two different base systems, a 13-slot rack-mountable VXI chassis and a 7-slot transportable VXI chassis. You choose the hardware modules, line interfaces, and test software to meet your specific testing requirements. You can use the same BSTS platform all the way from R&D and conformance testing through interoperability tests and field trials.



TS-5500

**Cellular Phone Test Platform:
Agilent TS-5500—A choice of
platforms for fast, cost-effective
cellular phone functional test**

The Agilent TS-5500 is designed for manufacturing functional test of GSM and CDMA mobile phones. Test engineers gain productivity by using this common test system core of both hardware and software, which can be tailored easily for different test requirements. You don't need to build test systems from scratch every time, because the TS-5500 can be implemented from start to volume production in half the time, with less risk. Test system developers can customize their use of VXI, instruments, and test routines to create test stands for different stages in phone manufacturing. The TS-5500 family gives you the means to accelerate your time-to-pre-production and time-to-volume while improving your asset utilization.

For expanding phone production lines, the TS-5500 test platform configures as a series of multiple-up tester that can test 1, 2, 3, or 4 phones per system. The TS-5500 reduces the cost of testing a phone with lower capital costs and faster test times. Since test system development begins with a pre-built system, new systems can be deployed quickly with fewer test engineering resources.

These platforms allow you to efficiently develop and perform tests such as:

- Phone tests and RF path support
- Audio tests
- Battery emulation and charging circuitry tests
- Low-frequency measurements
- Phone communication and control

The TS-5500 family offers choices for pre-production runs, startup manufacturers, those with low-to-medium volume needs, or powerful platforms designed to handle unusually short time-to-volume requirements.

A 25-year track record

Agilent offers a broad line of VXI data acquisition and control products for applications in the electromechanical world. Customers have employed Agilent data acquisition equipment to assist in the design of new airframe structures and products employing electrical/electronic controls and mechanical parts. Examples include turbines, internal combustion engines, industrial machinery, appliances, and much more. Some of these customers test the physical design attributes of products with mechanical components; others evaluate and monitor their manufacturing processes; and others conduct facility and environmental monitoring.

The transportation, construction, appliance, power generation, energy, chemical, pharmaceutical, and materials industries benefit from the product and process improvements made possible by Agilent data acquisition and control solutions. Similarly, high-performance engine manufacturers use Agilent's high-speed VXI scanning A/Ds to test a wide variety of engine and body systems in both ground and air transportation vehicles.

Agilent has been providing data acquisition and control solutions for over 25 years. Companies from all over the world seek out Agilent to help them find new ways to design and manufacture more efficiently, bring better products to market faster, and increase value while lowering costs—all leading to improved customer satisfaction.

Multiple-measurement applications

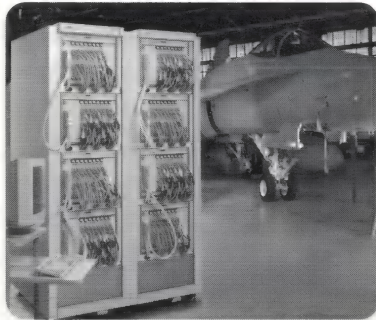
Most of these applications require a wide range of measurements such as voltage, current, temperature, pressure, strain, rotational speed, acceleration, vibration, noise and other parameters. When these measurements are conducted, the device under test usually requires some type of analog or digital control to test it under various conditions, a requirement easily fulfilled by Agilent VXI data acquisition and control systems. Structures such as airplane or automobile frames, for example, require the measurement of strain, mechanical resonance, and acoustic noise to ensure the quality and reliability of the product. Other applications require material evaluation, energy research, facility monitoring, environmental control, or remote station monitoring and control.

Agilent VXI data acquisition products provide various levels of capability and complexity to fulfill these many and diverse measurement and control applications. Systems based on Agilent VXI equipment can provide both acquisition and control capabilities to shorten your product design and development time.



VXI Solutions

03



Agilent Technologies delivers measurement tools and services designed for major land, sea, air and space programs. Whether you create, deploy or support test systems, Agilent VXI provides enhanced operational performance and availability.

Defense electronics

You can remain confident in the operational status of your electronic systems and subsystems—for the life of those systems—with off-the-shelf, open standard VXI measurement products from Agilent. Modular, open standard VXI products support you toughest requirements for long-lived test systems:

- Forward compatibility
- Compact size
- Transportability
- High performance

Test systems using VXI products from Agilent and other VXI suppliers have long been used in many commercial aerospace programs and defense-related programs for all branches of military service. Examples include US Navy/Marines CASS, HPDT, AMRAAM, AARGM, and TETS; US Army ERINT and IFTE; US Air Force AWACS, LANTIRN, and avionics test for numerous airplanes. VXI was accepted in the USAF MATE standard in August 1989.

Satellite communications

Success in the age of the Internet depends on your ability to anticipate new technologies and launch a dependable information infrastructure faster than ever before. Agilent VXI-based test systems are easy to integrate, helping you to meet your goals for schedule and cost.

Working with hard-to-measure signals—burst, hopped, modulated—is a fact of life for designers of today's high-performance communication systems. In RF/wireless/satellite communications applications, Agilent VXI vector signal analyzers let you characterize complex, time-varying signals with detailed spectrum, modulation, and waveform analysis.

Communications intelligence

Today's crowded airwaves present new challenges in communications intelligence. Operational realities compound the problem: you're expected to develop or intercept more signals with less equipment and fewer people. More than ever, successful missions depend on high productivity from system creators and operators. Agilent Technologies can enhance your productivity and protect your investment with adaptable, dependable and modular VXI systems and solutions. Whether the signals are stationary or moving, burst or continuous, low-level or high-power, Agilent VXI COMINT solutions let you deploy systems quickly and generate results rapidly.

Structures and propulsion

When you work with physical forces and systems, VXI-based tools can help you measure your prototypes and gain insights into your design. A unified set of tools can end the frustration of configuring a test system, acquiring the right data, analyzing the data, and optimizing your design. High-performance VXI digitizers make accurate event capture cost effective. Agilent VXI data acquisition and control systems extend your engineering senses and accelerate your design process.



Agilent has been providing automotive electronic manufacturers with leading-edge technology for many years. OEMs and AEMs from all over the world seek out Agilent to help them find new ways to bring better products to market faster, lower costs, improve quality, and increase customer satisfaction.

Agilent's test and measurement systems play a key role in developing and testing today's sophisticated automotive electrical systems. Satisfied automotive electronic manufacturers are using Agilent-based systems to functionally test engine control, ABS, airbag control, body, climate control, entertainment, and other modules. Automotive research groups use Agilent VXI-based systems to gather data in developing new and improved power train systems and in NVH testing.

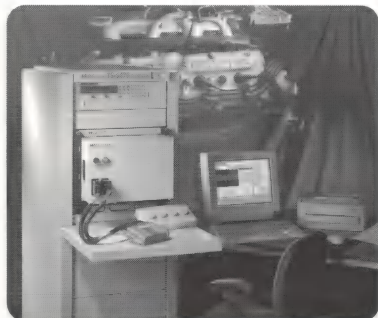
Systems designed for automotive testing

Agilent automotive test and measurement solutions are designed specifically for the automotive electronics industry. Agilent test solutions make vehicles more affordable by accelerating development cycles, eliminating waste, and improving the flow of information between manufacturing processes. They lower total manufacturing cost and increase vehicle reliability by verifying quality of subassemblies before they're integrated into the final product.

Proving ground: the real world

High-performance VXI- and GPIB-based platforms, such as the TS-5400 Series II automotive electronics test system, are available to test the electronic control units (ECUs) used in all parts of today's automobiles. These platforms ship as nearly complete solutions, with software, drivers, and VXI cards pre-installed. Designed to handle the high inductive and resistive loads encountered in automotive electronics, the Agilent TS-5400 Series II features high-speed test execution, compiled test code, action libraries tuned for high throughput, fast switching relays, and an open, standards-based architecture that supports off-the-shelf software and instruments.





Agilent TS-5400 Series II

Agilent TS-5400 Series II Automotive Functional Test Platform

For automotive electronics manufacturers facing time-to-market pressures, the TS-5400 Series II Platform accelerates functional test deployment, ensuring test development does not delay getting your automotive electronic control modules (ECMs) to market. The TS-5400 Series II ships as a complete measurement-ready platform, so you can be in production faster.

Current users of Agilent Technologies' platforms are reporting up to 50% time improvements in deploying functional test systems. And the TS-5400 Series II delivers the scalability and flexibility demanded by test and production managers and engineers. With the TS-5400 Series II platform, test engineering departments deliver more productivity because 70% of the test system development process is provided with the platform.

Platforms for a range of testing needs E8770A/E8780A/E8785A/E8786A

This family of platforms allows you to purchase "just enough test" resources to meet current ECM test requirements, and later add capabilities to the test system when

new ECMs move into production. These four base platforms test a wide range of automotive electronic control modules (ECMs). From simple ECMs, like immobilizers and RKE (remote keyless entry), to safety ECMs (airbag, ABS/TC) to complex ECMs (engine management systems), the TS-5400 Series II automotive functional test platforms provide the price/performance required to ensure that only quality products are shipped. These platforms are tuned for automotive electronic control module functional test and provide measurement resources, switching, a test executive, and a library of over 200 test routines tuned for automotive testing. Standard software development tools are included that enable test engineers to deploy test systems up to three times faster than building test systems from individual components. Racking and cabling are also included; optional fixturing that complements the TS-5400 Series II is available. All test platforms have the same operator interfaces and library of routines used to build test plans and associated measurement routines, and to leverage automation code and enterprise connectivity.

Development Software

Product No.	Description
Agilent VEE	Agilent VEE Pro and VEE OneLab
82345/51G	Agilent VEE PC Automation Kits
DAC Express	Data Acquisition/Recorder Software

Introduction

Agilent Technologies' test and development software has what it takes to provide you with the software you need for test and measurement. Use these to:

- Dramatically increase your productivity,
- Save you time to market with new products,
- Streamline your test development, and
- Help you improve your data quality.

With Agilent Technologies' software offering you now have software designed for test and measurement so you can create the programs and applications you need to get your products to market quickly. Agilent Technologies' development software offering is even broader when you include the many channel partners that work together to bring you even greater variety.

Overview: Development Software Choices

Agilent VEE 6.0: The Fastest Path from Measurement to Analysis

Agilent VEE 6.0 is a powerful graphical programming environment that builds on the foundation of HP VEE 5 with its intuitive approach to math analysis, visualization and signal processing. Now featuring embedded MATLAB[®] functionality, Agilent VEE OneLab (single user version) and Agilent VEE Pro (multi-user version) allow you to develop tests faster, analyze results more easily, and reach key insights more quickly than with any other programming environment.

- Agilent VEE supports the world's leading applications such as Microsoft[®] Excel Word, and Outlook, as well as all popular programming languages including Visual Basic, C, Visual C++ and LabVIEW.
- Agilent VEE Pro connects seamlessly to Microsoft Internet Explorer and Netscape Navigator, so you can easily share files and images with colleagues via the web.
- With MATLAB Script and The MathWorks Signal Processing Toolbox embedded in Agilent VEE, you get 500 of the most popular MATLAB analysis functions preprogrammed as one-click objects.

Choose from "OneLab" or "Pro"

Agilent VEE Pro 6.0 is a powerful graphical programming environment for fast measurement analysis results. The powerful analysis capability of MATLAB Script, fully integrated with Agilent VEE, gives users a wide selection of numeric computation tools, engineering graphics, and signal processing functions. VEE Pro 6.0 also supports ActiveX Controls that provide customization by adding application-specific functionality like barcode readers or video capabilities. Agilent VEE handles day-to-day programming tasks in instrument control, measurement processing and test reporting. It simplifies test development with enhancements for system integration, debugging, structured program design, and documentation. It automates instrument configuration, accelerates the creation of operator interfaces, streamlines test sequencing, and simplifies application development and program enablement across the Internet.

Or select Agilent VEE OneLab, a subset of Agilent VEE Pro that's an easy-to-learn, measurement-smart PC graphical programming environment designed for individual engineers and scientists who write simple measurement programs. It incorporates The MathWorks MATLAB Script and features from the MATLAB Signal Processing Toolbox and offers a robust measurement-programming environment that contains significant features from VEE Pro 6.0, including tutorials. Agilent has customized VEE OneLab for small-scale applications, to provide the easy-to-learn, measurement-smart programming software at a lower price.

More detailed information and a list of authorized Agilent VEE Partners are available in the Agilent VEE data sheet included in this publication.

Agilent VEE PC Automation Kits

Agilent also offers PC Automation Kits which combine the hardware, I/O software, and application software you need to automate your bench or test system at the best possible price. You can choose between the powerful graphical programming environment of Agilent VEE Pro, designed to support more instruments at once, larger programs, and sharing programs among engineers; or Agilent VEE OneLab, a subset of Agilent VEE Pro priced lower for standalone research & development applications.

See the Slot 0 and Computer Interfaces section of this publication for more information on the PC Automation Kits.

DAC Express Data Acquisition/Recorder Software:

Agilent DAC Express Data Acquisition/Recorder software improves the productivity of electromechanical and electronic engineers who test product functionality, specification margins, durability, and more. These tests can be set up quickly with no need for time-consuming debugging.

DAC Express is available as standalone software for use with your PC (Windows 95/98/NT/2000) and an IEEE-1394 I/O card connected to an Agilent VXI system. Various configurations that you can easily set up provide such capabilities as:

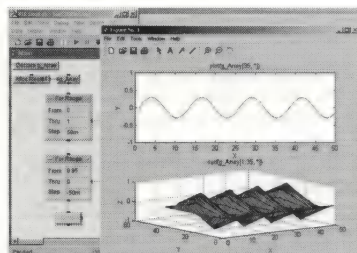
- Combined noise/vibration, high-level voltage, and low-level voltage, temperature, strain measurements
- Noise/vibration measurements
- High-level voltage, and low-level voltage, temperature, strain measurements
- Multi-function measurements of analog, digital, and rpm signals.

See the Agilent DAC Express data sheet in this publication for more information.

Agilent VEE 6.0

Agilent E2120G/E2123G

04



Agilent VEE

- Easy to learn and use—including seven built-in tutorials
- Features built-in analysis with full MATLAB® Script
- Performs smart measurements with embedded I/O configuration
- Includes standards friendly ActiveX Automation Server

It's Fast

Agilent VEE 6.0 is the fastest path from measurement to analysis in existence today. This powerful graphical programming environment builds on the foundation of HP VEE 5 with its intuitive approach to math analysis, visualization and signal processing. Agilent VEE 6.0 goes even further, adding a seamless approach to math analysis and visualization with embedded MATLAB functionality. With Agilent VEE OneLab (single user version) and Agilent VEE Pro (multi-user version), tests are developed faster, results are analyzed more easily, and key insights are reached more quickly than with any other programming environment.

It's Connected

With MATLAB Script from The MathWorks, Inc. built in, Agilent VEE is not only a great programming solution, it's also a great value. MATLAB Script and The MathWorks Signal Processing Toolbox are embedded in Agilent VEE. MATLAB Script provides extensive built-in analysis functionality, so without leaving your Agilent VEE program, you can manipulate, visualize and analyze key data instantly.

It's Multi-Lingual

Agilent VEE interacts with the world. It accepts data from any vendor's instrument. It supports the world's leading applications such as Microsoft® Excel, Word, Outlook and more. It supports all popular programming languages including Visual Basic, C, Visual C++ and National Instruments' LabVIEW. It works with surface-mount machines, robots and other manufacturing equipment via ActiveX. And it can be used as a standalone solution or included in a custom in-house solution.

It's Web Savvy

Agilent VEE Pro connects seamlessly to Microsoft Internet Explorer and Netscape Navigator, so you can easily share files and images with colleagues via the web. A huge variety of graphics formats are supported including .JPG, .BMP, .GIF, .WMF and .PNG in VEE OneLab and VEE Pro.



Built-In MATLAB

With MATLAB Script and The MathWorks Signal Processing Toolbox embedded in Agilent VEE, you get 500 of the most popular MATLAB analysis functions preprogrammed as one-click objects in Agilent VEE. These capabilities deliver unprecedented analysis and visualization capabilities in a single graphical environment, so without leaving Agilent VEE you can instantly transform your measurement data into usable information. Built-in MATLAB functions include:

- Numeric and symbolic computation
- Data analysis, manipulation and reduction
- Volume visualization
- Engineering and scientific graphics (2D, 3D, waterfall, bar, pie)
- Signal processing

High-Level Programming

Agilent VEE is an award-winning, uniquely productive, two-dimensional programming environment. To create a program, you choose high-level graphical objects from the menu and connect them with wires (no more low-level icons to represent each textual line of code). The wire connections help specify functionality and sequence in intuitive block diagrams. You program at a higher, task-oriented level using built-in scientific and engineering routines. And the program is self-documenting: Agilent VEE illustrates the connections between individual objects and the wires that join them to create a program, so even as programmers move on, their programs are easily understood by others. Plus, with its seven built-in tutorials and multiple sample programs, demos and context-sensitive help, Agilent VEE jumpstarts the programming effort and keeps it running smoothly for beginning and veteran programmers alike.

Smart Measurements

Agilent VEE is designed for productive instrument programming. Instrument addresses and other parameters can be verified at runtime and changed on the fly, without reconfiguring programs. Runtime executables can be created quickly with embedded I/O configuration, and you can distribute programs however you see fit.

Open Standards

Agilent VEE supports Microsoft functions: use Microsoft Word for reports, Excel for spreadsheets, Outlook for paging and e-mail, and Access for database operations. Agilent VEE programs fully support ActiveX, so Agilent VEE can be called from most PC applications, and the capabilities of the program can be extended using existing ActiveX controls. Agilent VEE programs can be monitored and diagnosed remotely via the web or network.

Flexible Interfaces

You're not required to create a front panel for an Agilent VEE program, but if you want to create a user interface without access to code, you simply add the objects you need to the front panel. Agilent VEE's compiler generates optimized code that can be further enhanced with its built-in Profiler. The Profiler allows you to quickly analyze critical sections of code to save development time when fine-tuning your programs. When you're ready to distribute your Agilent VEE program, you can automatically create a runtime executable directly from the menu. You get unlimited runtime with Agilent VEE.

Choose from "OneLab" or "Pro"

Agilent VEE is available in two configurations—as VEE OneLab and VEE Pro—to support single- and multi-user environments. Agilent VEE OneLab includes a subset of the features of Agilent VEE Pro and is priced for small-scale standalone research & development environments. It includes seven built-in multimedia tutorials for Windows®, plus many Agilent VEE program examples for Excel, MATLAB, Visual Basic and Visual C++. Like VEE Pro, Agilent VEE OneLab provides full MATLAB Script and The MathWorks Signal Processing Toolbox, adding 500 of the most common analysis functions prewritten as Agilent VEE objects, plus an additional 1,200 functions, at no extra charge. Also like Agilent VEE Pro, Agilent VEE OneLab includes almost a thousand drivers representing the most popular instruments from 70 different vendors, and can access popular PC applications (Excel, Word and Access). Both configurations of Agilent VEE 6 include embedded I/O for convenient runtime distribution, three new data types for ActiveX, and support for additional graphics (.JPG, .BMP, .GIF and .WMF).

(Agilent E2120G/E2123G continued)**Minimum System Requirements for Agilent VEE**

- PC with a 120 MHz Pentium® processor (266 MHz Pentium II or higher recommended)
- Microsoft® Windows 95/98, Windows NT® Workstation 4.0, or Windows 2000 operating system
- 32 MB RAM with Windows 95/98, 64 MB RAM with Windows NT/Windows 2000
- Hard disk free space:
Windows 95/98 (FAT 16/32 file system):
370 Mbytes Windows NT/2000 (FAT 16/FAT 32/NTFS file systems):
570/370/175 Mbytes respectively
- CD-ROM drive
- 15-inch monitor 800x600 (Super VGA) (17-inch or larger 1024x768 Ultra VGA recommended)
- Desired instruments and interface cards as needed (can be installed later)
- PC keyboard and 2-button mouse (3rd button, if present, is not used)

For More Information

For a free 60-Day VEE Pro 6.0 Evaluation Copy, or for information about available Agilent VEE site license, upgrade, educational and training products (not all available products are listed below), visit the Agilent VEE website at www.agilent.com/find/vee.

Ordering Information

Description	Product No.
VEE Pro 6.0 for Windows 95/98/NT/2000	E2120G
VEE Pro 6.0 ISA GPIB Automation Kit	82345G
VEE Pro 6.0 PCI GPIB Automation Kit	82351G
VEE Pro 6.0 HP-UX 10.2	E2111G
VEE OneLab 6.0 for Win 95/98/NT/2000	E2123G
VEE OneLab 6.0 PCI GPIB Kit	82353G

Note 1: A German version of any Agilent VEE product may be ordered by requesting Option ABD (no charge); a Japanese version of any Agilent VEE product may be ordered by requesting Option ABJ (no charge).

Note 2: VEE Pro ships with unlimited VEE Pro RunTime distribution rights, embedded MATLAB Script, The MathWorks Signal Processing Toolbox, and ActiveX capabilities at no extra charge. Full MATLAB can be purchased from The MathWorks at www.mathworks.com or call (508) 647-7000.

Authorized Agilent VEE Partners**Amplicon Liveline**

Amplicon Liveline is a specialist supplier of IT and instrumentation to industry. Offering a complete range of PC plug-in cards for data acquisition, serial and GPIB communications, industrial rack-mounted PCs and single board computers. PC hardware solutions are available from 16 different suppliers to ensure that Amplicon can meet the varied demands from industry, higher education, and research and development. All products offer support for Agilent VEE and are presented in a 408-page color catalog with full pricing and technical details.

Brighton, United Kingdom
+44 (0) 1273 570220
www.amplicon.co.uk

ComputerBoards, Inc.

ComputerBoards, Inc. offers a complete line of 12-bit and 16-bit PC data acquisition products. The 16-bit products include replacements for all standard 12-bit boards, including PCI and PCMCIA boards, high-channel-count analog input boards, and 1 MHz 16-bit ISA and PCI boards. The Universal Library provides drivers for Agilent VEE.

Middleboro, Massachusetts, USA
(508) 946-5100
www.computerboards.com

Data Translation Inc.**DATA TRANSLATION®**

Data Translation Inc. designs, manufactures and sells data acquisition, image processing, and machine vision hardware and software. Data Translation makes DT VPI (visual programming interface) software that is an elegant interface allowing Agilent VEE users to configure and control virtually all Data Translation data acquisition boards. Data Translation offers a wide selection of high performance PCI, USB, ISA PC plug-in data acquisition hardware.

Marlboro, Massachusetts, USA
(508) 481-3700
www.datatranslation.com

The MathWorks Inc.

The MathWorks, Inc. develops, markets, and supports MATLAB, Simulink, and a family of data analysis toolboxes for engineers, scientists, and technical professionals. MATLAB provides the foundation and computational engine for all of The MathWorks products. Widely recognized as the industry's premier language for technical computing, MATLAB provides comprehensive math and visualization functionality, and a powerful high-level language for users to interactively explore, analyze, design, and prototype solutions to their problems. The MathWorks products are used throughout the world in industries such as automotive, aerospace, environmental, telecommunications, computer peripherals, finance, and medical. More than 500,000 users at the world's leading industrial, government, and education organizations rely on The MathWorks products for tremendous gains in productivity.

Natick, Massachusetts, USA
(508) 647-7000
www.mathworks.com

Meilhaus Electronic

Meilhaus Electronic data acquisition products cover a range of hardware and software products for standard applications as well as for highly sophisticated test, measurement and control systems based on a PC platform. Products include data acquisition cards for PCI and PCMCIA bus, IEEE-488 cards, GPIB/LAN gateway, sensor modules, intelligent sensor interfaces, and system integration services.

Puchheim, Germany
+89 \ 89 01 660
www.meilhaus.de

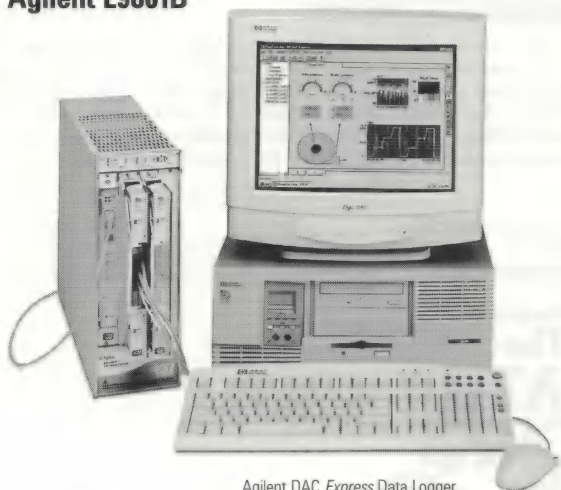
MATLAB® is a U.S. registered trademark of The MathWorks, Inc.
Microsoft®, Windows®, Windows NT®, and MS Windows® are U.S. registered trademarks of Microsoft Corporation.
Pentium® is a U.S. registered trademark of Intel Corporation.

Publication No.: 5980-0842EUS

Agilent DAC Express Data Acquisition/Recorder Software

Agilent E9801B

04



Agilent DAC Express Data Logger

- Combined measurements of noise, vibration, temperature, pressure, strain, resistance, voltage, digital states, and rpm
- Intuitive user interface reduces system development time by 10x
- Replaces analog or digital tape recorders
- Online monitoring assures confidence in measurements
- Post-test data viewing mode helps find events of interest
- Saves time with formatted output to analysis and reporting packages

Description

Agilent Technologies' Agilent DAC Express Data Acquisition/Recorder requires *no programming* and thus dramatically improves the productivity of electro-mechanical and electronic engineers. Tests such as design verification, durability, and regulatory compliance can be set up quickly with no need for time-consuming debugging.

There are several system configurations that you can easily set up with DAC Express, your PC (MS Windows 95/98/NT/2000), and an IEEE-1394 I/O card (E8491B). These systems use the C-size VXI architecture for unmatched data integrity and throughput speed and can be easily upgraded for more measurement channels. These various configurations provide the following capabilities:

- Combined noise/vibration, high-level voltage, and low-level voltage, temperature, strain measurements
- Noise/vibration measurements
- High-level voltage, and low-level voltage, temperature, strain measurements
- Multi-function measurements of analog, digital, and rpm signals.

The source of test data is never in question because system setup, test descriptions, and related documents are stored with the test data. This provides a unique identification and also a means of system setup for repeating the test.

For more information about these configurations, please refer to the Agilent Technologies Data Acquisition Website at www.agilent.com/find/data_acq.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Agilent DAC Express Systems at a Glance

Using your own PC, it's a simple process to install the DAC Express software and the Agilent IEEE-1394 PCI card (high-speed serial I/O) and set up these configurations.

Data Recorder/Logger Configuration

Combining high-speed measurements of noise or vibration signals and low-speed measurements of temperature, strain, and more, this is the workhorse system of its class. High-speed sample rates can be set up to 51.2 KSa per second per channel. Low-speed scanned sample rates can be set up to 1.25 KSa per second per channel for 64 channels.

In the standard configuration, all data goes to the host PC hard drive.

For higher data transfer rates, using a VXI data disk, the high-and low-speed data streams go to separate disks, ensuring continuous data rates of up to 5 MSA/sec for high-speed measurements and more than 400 KSA/sec for low-speed measurements (uses E1432A and E1413C measurement modules).

Data Recorder Configuration

If your need is for noise and vibration measurements only, using microphones, accelerometers, or other voltage transducers, just connect your inputs and go. Real-time displays include time records and single-block FFTs (uses E1432A measurement module).

Data Logger Configuration

The simple name understates its power. Focusing on low-speed measurements of temperature, strain, and so on, this system starts with 16 channels but can expand to 64 channels per slot and 768 channels total in the optional 13-slot mainframe. The channel scan rate can be up to 1.25 KSA/sec for 64 channels. The data-to-disk transfer rates of greater than 400 KSA/sec (for multiple modules) can be maintained while online monitoring displays show key values for the operator (uses E1413C measurement module).

Multi-function Data Logger Configuration

Sometimes you need more than just analog data. If your job requires recording digital states, relay settings, shaft rpm, pulse train rates, or similar parameters in addition to analog signals, this system is the answer. You can configure a mix of channel types, up to 196 channels in the standard 4-slot mainframe, or up to 768 channels in the optional 13-slot mainframe (uses E1419A multifunction module).

Get Your Own Custom System

If these systems don't exactly meet your needs, contact your Agilent sales representative to talk about other configurations that can provide the flexibility you need.

No Programming Required

The intuitive software user interface (E9801B) simplifies the time-consuming tasks of:

- Configuring hardware
- Conditioning transducers
- Setting measurement rates
- Developing display routines
- Creating data files
- Exporting data for analysis and report generation

It's all as simple as 1-2-3:

1. Set up
2. Record
3. View

Share the View

Design engineers and others outside the test department can be included. They can look at the equipment setup file and replay collected data through the same displays as used during the actual test.

For More Information

Agilent DAC Express Data Acquisition/Recorder Systems Product Overview, Pub. No. 5968-6132E; DAC Express Technical Specifications, Pub. No. 5968-0431E

Product Specifications

Measurement

rate: Noise/vibration: up to 51.2 KSA/sec/ch
Voltage, temp., etc.: up to 2 KSA/sec/ch

Data throughput

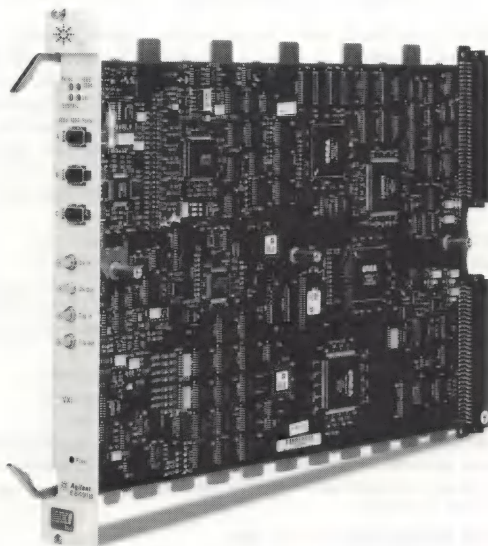
rate: Noise/vibration: up to 5 MSA/sec to VXI data disk
Voltage, temp., etc.: up to 400 KSA/sec to PC hard drive

Ordering Information

Description	Product No.
DAC Express Software Release 2.0	E9801B

Publication No.: 5968-0431E

Agilent E8491B IEEE-1394
PC Link Interface



C-Size VXI Modules

Product No.	Description
E1406A	VXI GPIB Command Module, C-Size
E8491B	IEEE-1394 PC Link to VXI, C-Size

VXI Direct Access Interface

The IEEE-1394 PC link Interface is ideal for high-performance systems that use an external PC controller. It connects your PC directly to the VXI backplane without having to go through a slower GPIB interface or command module. Multiple mainframes can be connected to one interface delivering flexibility and high data throughput. The Agilent Technologies E8491B IEEE-1394 PC link interface includes a C-size VXI Slot 0 module and a 4.5-meter cable. An IEEE-1394 PCI card to install in your PC is orderable as an option.

Command Module

The Agilent E1406A is a powerful resource manager that allows you to access any manufacturer's register-based device, shared memory, and Slot 0 functions, as required by the VXIbus Specifications. The E1406A may be used in the Agilent E1401B, E1421B, or any vendor's mainframe. Agilent's command modules provide an IEEE-488 (GPIB) interface that links your VXI system to the external world, plus the intelligence to drive register-based devices. This will let you develop and debug your tests quickly.

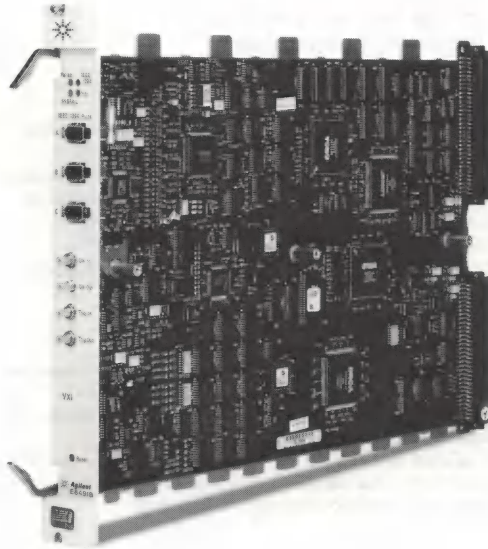
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Model	E1406A	E8491B
	C-Size Command Module	IEEE-1394 PC Link-to-VXI
VXI Characteristics		
Size:	C	C
Slots:	1	1
VXI device type:	Message-based commander	Message-based commander
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.		
VXIplug&play Win Framework:	Yes	No
VXIplug&play Win95/NT Framework:	Yes	No
VXIplug&play HP-UX Framework:	No	n/a
Specifications		
Backplane/interface:	IEEE-488	PCI 2.1 or higher
Trigger In/Out:	Yes	Yes
Clock:	Yes	Yes

IEEE-1394 PC Link to VXI, C-Size

Agilent E8491B

05



Agilent E8491B

- C-size, 1-slot, message-based commander
- Industry standard PC-to-VXI interface
- High-performance data block transfers
- Ease of configuration with hot plug-in capability
- Supports multiple mainframes with one PC
- Timing and triggering to external devices/mainframes

Description

The Agilent Technologies E8491B IEEE-1394 PC Link to VXI is a C-size, 1-slot, message-based VXI module, providing a direct connection from your PC to a VXI mainframe via the industry standard IEEE-1394 bus (FireWire).

The E8491B is a high-speed C-size device with Resource Manager and Slot 0 capability. Its logical address is 0, therefore it is always the mainframe's Resource Manager and is typically installed in mainframe Slot 0. The high speed is accomplished, in part, through the use of small signals (200 mV) that are transmitted differentially over the twisted-pair wire set with controlled-impedance characteristics. The differential signal provides high-noise immunity.

The E8491B includes a C-size VXI Slot 0 module and a 4.5-meter cable. Ease of configuration is achieved with automatic recognition of a new IEEE-1394-based device without powering down the PC, known as "hot plug-in".

The E8491B Option 001 is an OHCI-based IEEE-1394/PCI host adapter card. It is a PC plug-in card capable of transferring data at up to 400 Mbits/second. The card has three external 1394 ports. If required, the OHCI-based IEEE-1394/PCI card can supply 12V at up to 1.5A for IEEE-1394 devices that require power.

Refer to the Agilent Technologies Website (www.agilent.com/find/vxi) for recent product updates, if applicable.

IEEE-1394 Applications

The E8491B is well suited for data acquisition applications moving large blocks of data, and it is a cost-effective choice for test applications when used with Agilent's E84XX mainframe series. For multiple VXI mainframe systems, one E8491B is installed into each mainframe and these are interconnected via the cable in a daisy-chain, tree or star configuration. Up to 16 mainframes can be supported from one PC. This reduces the system cost further since an additional OHCI-based IEEE-1394/PCI card is not needed for each added mainframe.

The E8491B includes clock and triggering capabilities, plus complete SICL/VISA I/O library software for the Windows® 95/98/Me/NT® 4.0/2000 environments. The interface also supports 32-bit Interpreted SCPI (I-SCPI).

What is IEEE-1394?

'FireWire', 'IEEE-1394', 'IEC 1883'. These titles refer to a high-speed serial bus that is literally a new standard for transmitting data between PCs and consumer electronics. 'FireWire', as named by its inventors at Apple Computer Inc., was born out of the need for a low-cost, consumer oriented connection for applications where large amounts of digital audio and video data is recorded, edited, stored, and transferred between devices. The bus' performance, flexibility, and ease-of-use resulted in an implementation as an I/O interconnect (Agilent E8491B) between external PCs and C-size VXI mainframes.

IEEE-1394's reduction in cost is, in part, achieved through serial data transfer, which uses a simplified cable design. The IEEE-1394 cable medium allows up to 16 physical connections (cable hops) on one bus segment, each up to 4.5 meters in length. (The cable supplied with the E8491B is 4.5 meters.) This gives a system using IEEE-1394 a total cable distance of 72 meters. The data is transmitted over one of the cables' twisted-pair sets, while the other twisted-pair set is used for the clock. The clock makes a transition when the data line does not, allowing a simple, exclusive-OR gate to be used for clock recovery.

IEEE-1394's reduction in cost and ease of use are also attained through simplified electronics. Its transmitters and receivers, which are available as a standard chip set, handle addressing, initialization, arbitration and protocol. The plug-and-play nature of the IEEE-1394 bus is also achieved in this chip set. Node addresses, for example, are assigned to devices on the bus upon power-up.

Data transfer over the IEEE-1394 bus can be either Asynchronous or Isochronous. Both types can occur on the same bus. Isochronous data transfers broadcast variable amounts of data to multiple 'channels' at a regular intervals with no acknowledgment. Asynchronous data transfers use a 'fair arbitration' protocol to ensure each IEEE-1394 device has equal access to the bus. The E8491B supports asynchronous data transfers to secure equal access for each VXI mainframe.

Large Block (>64 Kbytes) Data Transfer Rate

	D16 Read Kbytes/s	D16 Write Kbytes/s	D32 Read Kbytes/s	D32 Write Kbytes/s
Agilent E8491B FireWire	8600	10200	12000	14000
Agilent E1406A GPIB	700	700	N/A (Not supported)	N/A (Not supported)
Agilent E6235A 200 MHz Embedded VXI PC	8500	1600	14000	3100

Product Specifications

Interface Characteristics

Operating system:	Windows 95/98/Me/NT 4.0/2000
Controllers:	PC based
I/O Library:	SICL/VISA
PC backplane:	PCI 2.1 with latest BIOS
Max. sustained data transfer:	
16 bit:	14 MB/sec
32 bit:	14 MB/sec
Max. backplane burst rate:	
16 bit:	13 MB/sec
32 bit:	27 MB/sec
64 bit:	53 MB/sec
Languages:	C/C++, Visual Basic, Agilent VEE, LabVIEW/VISA, LabWindows/VISA

General Characteristics

Interface:	IEEE-1394
Slot 0 functions:	Yes
Resource manager:	Yes
Extended VXIbus resource manager:	Yes
CLK10:	Yes

CLK10

Input:	TTL
Output:	TTL
Stability:	± 100 ppm

(Agilent E8491B continued)

Trigger Input

Levels:	TTL, ECL, CMOS, ± 30 V
Input load:	55 k Ω , 50 pF
Maximum rate:	2 MHz
Minimum pulse width:	200 ns
Maximum trigger delay:	300 ns

Trigger Output

Max level:	+ 30 V
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Cable Length

Maximum lengths:	4.5 m between devices
Bus maximum length:	72 m total per system
Maximum number of mainframes per system:	16

General Specifications

VXI Characteristics

VXI device type:	Message-based commander
Data transfer bus:	A16, A24, A32, D08, D16, D32, D64
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	128 kB
VXI buses:	TTL Trigger Bus, ECL Trigger Bus

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	2.5	0.001
+12 V:	0.35	0.050
-12 V:	0.015	0.001
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0.180	0.001
-2 V:	0.360	0.001

Cooling/Slot

Watts/slot:	20
ΔP mm H ₂ O:	0.10
Air flow liter/s:	2.0

Ordering Information

Description	Product No.
IEEE-1394 PC Link to VXI, C-Size	E8491B
OHCI-Based IEEE-1394/PCI Card	E8491B 001
Upgrade Kit E8491A to E8491B Performance	E8491B UP1
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E8491B W01
E8491B Front Panel (See Note 1)	E8491-00202
FireWire Cable, 4.5 m (See Note 2)	E8491-61603

Note 1: Upgrade existing E8491A to E8491B performance with E8491B Opt. UP1 Upgrade Kit. This kit includes OHCI-based IEEE-1394/PCI card and E8491B software. To upgrade E8491A to E8491B physical appearance, install E8491B Front Panel (part number E8491-00202) and new 4.5 m FireWire Cable (part number E8491-61603). Original Agilent E8491A warranty remains in place after upgrade.

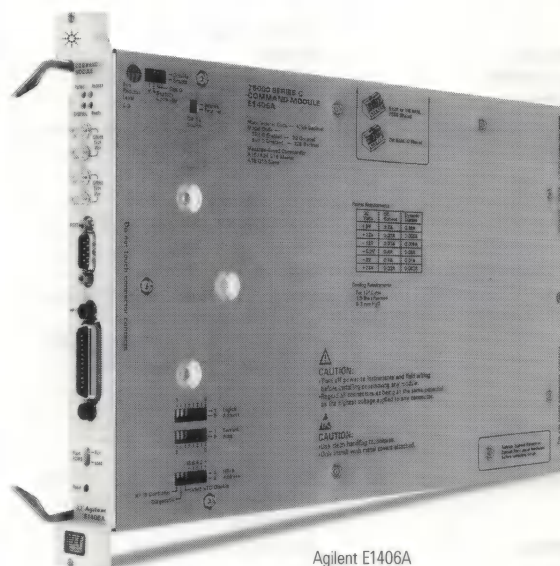
Note 2: FireWire cables are available in other lengths and can be ordered from: Molex, Inc., Telephone: (800) 78-MOLEX <http://www.molex.com>.

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Publication No.: 5966-2878E

VXI GPIB Command Module, C-Size

Agilent E1406A



Agilent E1406A

- 1-Slot, C-size, message-based commander
- GPIB, RS-232, Slot 0, and Resource Manager
- 2 MB RAM
- MXIbus protocol support for high throughput
- Easy to program as message-based instruments

Description

The Agilent Technologies E1406A Command Module is a C-size, 1-slot VXI message-based commander that provides Slot 0 and Resource Manager functions. It can act as a VMEbus system controller and GPIB (IEEE-488)-to-VXIbus interface device for transparently communicating with any manufacturer's message-based VXI modules. The E1406A Command Module has FLASH memory for downloadable drivers, so you can program Agilent register-based devices using the high-level SCPI programming language. It also translates SCPI commands for register-based instruments and therefore, makes these VXI devices as easy to program as message-based instruments.

This command module also includes a MXIbus Resource Manager for VXIbus extensions. This allows you to maintain high-throughput performance in multiple mainframe systems. With its flexible triggering and clock interfacing, you can synchronize the VXI backplane 10 MHz clock to an external TTL signal.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

General Characteristics

Processor:	16 MHz 68000
Interface:	IEEE-488
Clock accuracy:	0.005% elapsed time
Memory:	1.75 MB FLASH max. 2 MB RAM max.
Shared memory:	512 KB max.
Agilent IBASIC:	Yes
Slot 0 functions:	Yes
Resource manager:	Yes
MXIbus resource manager:	Yes
CLK10:	Yes
Temperature coefficient:	0.001%, to 0.012% of time since last set (per °C change in temperature)
Resolution:	1.0 s

(Agilent E1406A continued)

CLK10

Input:	TTL or low-level ac
Minimum input level:	40 mV p-p
Maximum input level:	42.5 V p-p
Output:	TTL
Jitter:	0.03% (-55 dB)
Initial accuracy:	50 ppm
Maximum stability:	± 20 ppm/year (0-55° C)
Typical stability:	± 3 ppm/year at 25° C

Trigger Input

Levels:	TTL
Input load:	55 k Ω , 50 pF
Maximum rate:	12.5 MHz (TTL), 40 MHz (ECL)
Minimum pulse width:	30 ns (TTL), 12.5 ns (ECL)
Maximum trigger delay:	30 ns

RS-232 Interface (for terminal only)

Baud rate:	300, 1200, 2400, 4800, 9600, 19200
Parity:	Even, Odd, One, Zero, None
Character size:	7, 8
Pace:	Xon/Xoff, None
Hardware handshake:	DTR, RTS
Buffer size:	16 characters
RS-232 terminals supported:	HP 700/92, HP 700/94, HP 700/22, HP 700/43; WYSE WY-30, DEC VT100, DEC VT220

VXI compliance: Revision 1.4 compliance

General Specifications**VXI Characteristics**

VXI device type:	Message-based commander
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	Yes
VXI buses:	Local Bus A TTL Trigger Bus ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

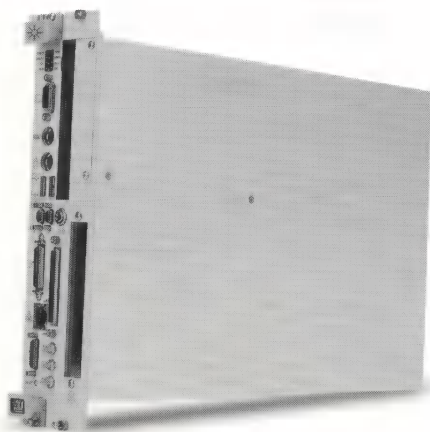
Watts/slot:	19.00
ΔP mm H ₂ O:	0.30
Air Flow liter/s:	1.50

Ordering Information

Description	Product No.
VXI GPIB Command Module, C-Size	E1406A
Service manual	E1406A 0B3
Taiwan - Chinese localization	E1406A AB0
Korea - Korean localization	E1406A AB1
China - Chinese localization	E1406A AB2
Germany - German localization	E1406A ABD
Spain - Spanish localization	E1406A ABE
France - French localization	E1406A ABF
Japan - Japanese localization	E1406A ABJ
Italy - Italian localization	E1406A ABZ
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E1406A W01
5 Yr. Return Repair Service	E1406A W50

Publication No.: 5965-5545E

Agilent E9851A

**VXI Embedded PCs**

Product No	Description
E9851A	VXI Embedded PC (700 MHz, Win NT 4.0)
E6235A	VXI Pentium® MMX™ PC (200 MHz, Win NT)

VXI Embedded Workstation Computer

Product No.	Description
E1498A	V743/100 VXI Embedded Computer

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Introduction

Agilent Technologies provides VXI embedded computers based on the industry-standard operating systems Windows NT and HP-UX. Agilent's VXI embedded computers integrate high functionality into small modules for use within C-size VXI mainframes. Agilent's embedded computers give you the right capability to meet your test system needs.

Overview: Computer Choices

If you need a PC-based system with the high-performance I/O of VXI, Agilent offers the E9851A and E6235A. These PCs combine the high I/O performance of direct VXI backplane support, the space-saving size of embedded computers, and the high power of the Intel Pentium processors. A variety of applications use these computers – these include standalone VXI systems, mixed systems with VXI and GPIB instruments, and distributed systems networked together.

The E9851A VXI Embedded PC brings the power of a 700 MHz Pentium III (or better) processor to your embedded VXI applications. It supports Agilent SICL/VISA and is VXI *plug&play* compatible with Windows NT 4.0. This two-slot, C-size module includes 128 MB of RAM (expandable to 384 MB), a 6 GB Ultra DMA 33 (or better) hard drive, a 3.5-inch floppy drive, and a host of standard I/O ports.

The V743 VXI (E1498A) embedded computer offers HP-UX workstation performance in an integrated C-size package. This computer provides the performance of Hewlett-Packard's 7100LC PA-RISC architecture with a clock rate of 100 MHz. Also, the V743 computer supports all VXI addressing modes (A16, A24, A32), programmable interrupt handling, and single channel DMA for VXI extended memory devices.

Pentium® is a U.S. registered trademark and MMX™ is a U.S. trademark of Intel Corporation.

Family Specifications

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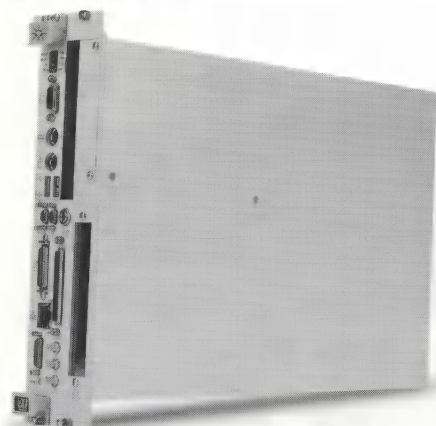
Model	E6235A	E9851A	E1498A
	VXI Pentium® PC 200 MHz/32 MB	VXI Embedded PC 700 MHz/128 MB	V743 VXI Embedded Computer
VXI Characteristics			
Size:	C	C	C
Slots:	2	2	1
Specifications			
Processor:	Pentium MMX™	Intel Pentium III (or better)	PA 7100LC
Clock speed:	200 MHz	700 MHz	100 MHz
Main memory:	32 - 128 MB	128 - 384 MB	32 - 128 MB
Built-in interfaces:	Two PS-2 ports SVGA w/2 MB Video RAM LAN GPIB ECP Parallel RS-232 SCSI-2 USB Trigger I/O Clock I/O	Wide Ultra SCSI-3 port (AGP) 2 MB 64-bit accelerated SGRAM SVGA port 10/100 BaseT Ethernet port IEEE 488.2 GPIB port Two RS-232 serial ports IEEE-1284 parallel port	GPIB (2) RS-232 (1) SCSI-2 SE LAN AUI
Expansion slots:	1 EXM	Two External PC Card One Internal PC/ISA	none
Internal mass storage:	2.16 GB Hard Drive 3.5-in. Floppy Drive	6 GB Hard Drive (or better) 3.5-in Floppy Drive (*see Note below)	Optional External: See Data Sheet
O.S. (earliest supported):	Windows NT 4.0	Windows NT 4.0	HP-UX 9.05

***Note:** Processor, RAM and hard disk technologies are improving rapidly, so the E9851A processor, RAM and hard disk may be upgraded without notice.

Pentium® is a U.S. registered trademark and MMX™ is a U.S. trademark of Intel Corporation.

VXI Embedded PC, 700 MHz

Agilent E9851A



Agilent E9851A

- 2-Slot, C-size, message based
- 700 MHz Intel Pentium® III Processor (or better)
- VXIplug&play compatible with Windows NT® 4.0
- VISA and SICL support
- 128 MB standard SDRAM memory

Description

The Agilent Technologies E9851A is a C-size, 2-slot, message-based VXI embedded PC running Win NT 4.0 operating system. The E9851A can be embedded in various Agilent VXI mainframes including the E84XX series, E1401B or E1421B.

Standard features include a 6 GB (or larger) Ultra DMA 33 (or better) hard drive/disk, a 3.5-inch 1.44 MB floppy drive, and 128 MB RAM standard memory that can be expanded to 384 MB using standard SODIMMs in two free sockets.

Standard features also include an internal AT/PCI expansion slot that accepts a full-length PCI card, or a 16-bit XT-height ISA bus card. In addition, two front panel slots can accept one Type I/II/III and one Type I/II PC card (PCMCIA) peripherals.

Several standard I/O ports include an Advanced Graphics Port (AGP), a 2 MB 64-bit accelerated SGRAM port for SVGA connection, a Wide Ultra SCSI-3 port, a 10/100 BaseT (RJ45) Ethernet port, an IEEE 488.2 GPIB port, two RS-232 serial ports, an IEEE-1284-compatible parallel port, and two USB ports. (Note: USB not supported in Win NT 4.0.) A PS/2 keyboard and PS/2 mouse are required but not provided; a PS/2 keyboard adapter is provided.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Note: The Agilent E9851A includes a 2.5-inch hard drive designed for relatively low-usage notebook PC applications. For applications requiring more than one disk read/write per minute over continuous long periods, premature hard drive failure may occur. For such applications, consider using an external SCSI hard drive.

Product Specifications

Processor:	Intel Pentium III (or better)
Clock speed:	700 MHz
O.S. (earliest supported):	Windows NT 4.0
Internal mass storage:	6 GB Hard Drive 3.5-in. Floppy Drive (see Note below)
Main memory:	128 MB standard expandable to 384 MB using SODIMMS
Available internal slot:	Accepts full-length PCI or 16-bit XT-height ISA card
Available front panel slots:	Two PC card (PCMCIA) slots that accept one Type I/II/III and one Type I/II cards
Standard built-in interfaces:	Wide Ultra SCSI-3 port (AGP) 2 MB 64-bit accelerated SGRAM SVGA port 10/100 BaseT Ethernet port IEEE 488.2 GPIB port Two RS-232 serial ports IEEE-1284 parallel port Two USB ports* * (not supported in Win NT 4.0)
Included cables:	GPIB cable RS-232 cable IEEE-1284-2 cable (printer) PS-2 keyboard adapter (DIN 5F/MINI 6M)

Advanced Graphics Port (some of the supported resolutions):

Resolution	Number of colors
640 x 460	16 M colors
800 x 600	16 M colors
1024 x 768	64 K colors
1280 x 1024	256 colors
1600 x 1200	256 colors

Additional front panel connectors/functions:

10 MHz Clock I/O SMB connector
Trigger-In SMB connector
Trigger-Out SMB connector
Audio Out (speaker) connector
Keyboard connector
Mouse connector

Front panel LEDs:

VXIbus interface status LEDs (indicate initialization stages as PC boots):

FAIL
SYSF
ONLINE
PWROK

Board access LEDs (indicate that board resources have been accessed):

ACC
DRV
SCSI

Ethernet LEDs (indicate Ethernet interface status):

RX/TX
LNK
100B-T

Note: Processor, RAM and hard disk technologies are improving rapidly, so the Agilent E9851A processor, RAM and hard disk may be upgraded without notice.

(Agilent E9851A continued)

Environmental Specifications

EMC specifications:	Meets CISPR 11, 1990/EN 55011 (1991): Group 1, Class A FCC Class A verified
EMI specifications:	MIL-T-28800E Class 3 (30 g peak, half sine shock pulse). Also meets IEC 60068-2-27.
Functional shock:	MIL-T-28800E MIL-STD-810E Category 1
Random vibration:	5 to 500 Hz, 0.3 g _{rms} , 3-axes 5 to 500 Hz, 2.4 g _{rms} , 3-axes
Operating:	5 to 500 Hz, 0.3 g _{rms} , 3-axes
Non-operating:	5 to 500 Hz, 2.4 g _{rms} , 3-axes
Operating environment:	
Ambient temperature:	0 to 50 °C
Relative humidity:	10% to 90% non-condensing
Storage environment:	
Ambient temperature:	-20 to +70 °C
Relative humidity:	5% to 95% non-condensing
Maximum altitude:	
Operating:	10,000 ft
Non-operating:	40,000 ft

General Specifications

General Characteristics

Dimensions:	233.4 mm high x 340 mm deep (9.2 in. x 13.4 in.)
Weight:	2.5 Kg (5.5 lbs.)
VXI slots required:	2

VXI Characteristics

VXI device type:	Message based
Size:	C
Slots:	2
Connectors:	P1/P2
VXI buses:	TTL Trigger Bus ECL Trigger Bus

Cooling/Slot (preliminary)

Watts/slot:	24/slot (48/2-slots)
ΔP mm H₂O:	0.07
Air flow liter/s:	1.9

Module Current (preliminary)

	I _{PM}	I _{DM}
+5 V:	9.0 A	4.0 A
+12 V:	70 mA	30 mA
-12 V:	10 mA	10 mA
+24 V:	1 mA	1 mA
-24 V:	1 mA	1 mA
-5.2 V:	350 mA	30 mA
-2 V:	100 mA	6 mA

Ordering Information

Description	Product No.
VXI Embedded PC, 700 MHz (Includes operating manuals)	E9851A*
128 MByte PC100 SODIMM RAM Module	E9851A 001
Convert to 1-year on-site warranty	E9851A W01

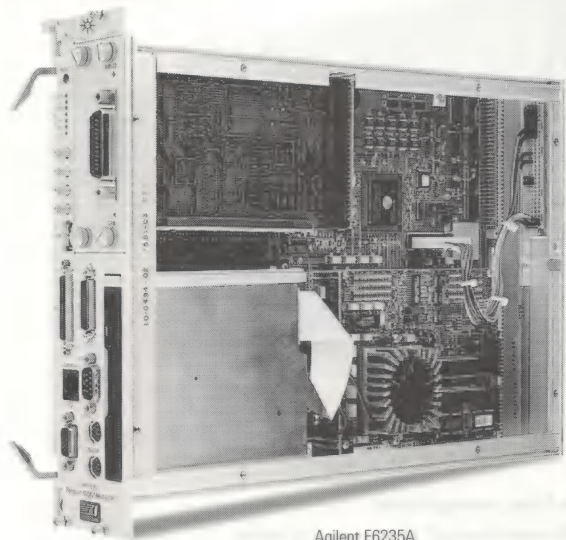
* Standard warranty is one year return-to-Agilent.

Windows NT® is a U.S. registered trademark of Microsoft Corporation. Pentium® is a U.S. registered trademark of Intel Corporation.

Publication No.: 5988-2350EN

VXI Pentium® PC 200 MHz/32 MB

Agilent E6235A



Agilent E6235A

- 2-Slot, C-size, message-based
- 200 MHz Intel Pentium MMX™ Processor
- SICL/VISA support
- Upgrade memory using standard SODIMMS
- VXI plug&play-compatible with Windows NT®
- Additional I/O interfaces available

Description

The Agilent Technologies E6235A is a C-size, 2-slot, message-based, PC and can be used in either the Agilent E84XX series, the E1401B, or the E1421B Mainframe. Embedding the computer in the VXI chassis allows direct computer access of other VXI devices, system memory, and triggers as though they were part of the computer hardware. Therefore, you don't need a separate command module.

The E6235A accesses the VXIbus with a full 32-bit wide data path (D32) for highest performance. A LAN connection is standard for network connectivity. It has one additional EXM slot for inclusion of an additional interface that can be ordered separately.

This product includes a 200 MHz processor, 2.16 GB disk, 3.5" floppy drive, 32 MB RAM, SCSI-2, RS-232, GPIB, ECP parallel port, SVGA I/F with 2 MB VRAM, two PS-2 ports, and one EXM expansion slot.

Note: This product uses a notebook-style 2.5" hard drive intended for low-usage operation. Applications that require frequent (more than once per minute) disk read/writes continuously over long periods may cause premature failure of the hard disk. For these applications, you should consider using an external SCSI hard drive, either a standalone drive or a VXI disk module such as the E3249B.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

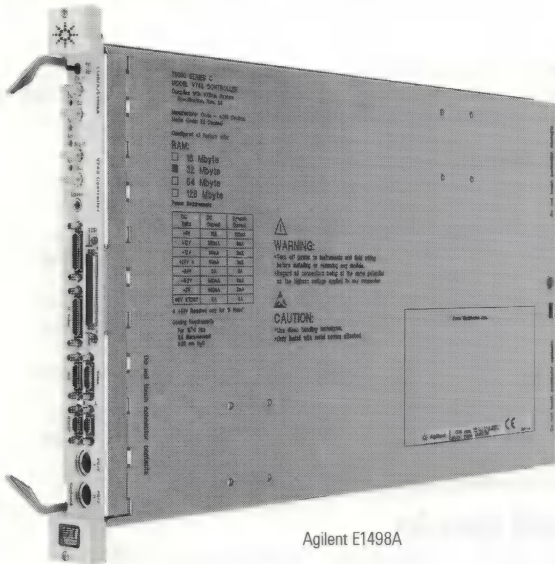
Ordering Information

Description	Product No.
VXI Pentium® PC, 200 MHz/32 MB	E6235A
16 Mbytes Additional RAM	E6245A
Additional AUI/ThinLAN/10baseT Interface	RADIS-00724
Additional GPIB Interface	RADIS-00848
Additional 2-Channel RS-232 Interface	RADIS-00849

Publication No.: 5968-1690E

V743/100 VXI Embedded Computer

Agilent E1498A



Agilent E1498A

- 1-Slot, C-size, message-based computer
- Direct VXI access with PA-RISC technology
- Compatibility with HP Series 700 workstations/computers
- C-SCPI and Agilent VEE support
- Includes SICL and VISA with special enhancements
- VXIplug&play-compatible with HP-UX drivers

Description

The Agilent Technologies V743/100 embedded computer (E1498A) is a **C-size, 1-slot, VXI module**. This high-performance message-based computer uses Hewlett-Packard's PA-RISC technology to deliver extraordinary performance and direct VXI access at a very competitive price.

Developed specifically as an embedded HP-UX (UNIX) computer for VXI, the V743 computer provides the high I/O performance of direct VXI backplane support, the space savings of an embedded computer, and the high power and speed of HP PA-RISC all in an HP-UX environment. The V743 supports all VXI addressing modes (A16, A24, and A32), programmable interrupt handler, single-channel DMA for VXI extended memory devices, and a 1 MB dual-ported memory buffer for high-speed data acquisition.

Note: You may use only one embedded computer in a system.

The V743/100, with its high-speed 100 MHz 7100LC PA-RISC processor, is ideal for development of run-time applications. This model is completely compatible with other HP 9000 Series 700 workstations and computers. However, it requires HP-UX releases 9.05 and later. With HP-UX, you can set up industry-standard networking, windowing systems, and languages. Databases and a full range of VXI-related software are available for automated test applications.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

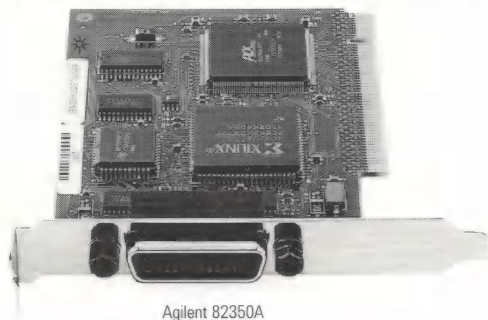
Ordering Information

Description	Product No.
V743/100 VXI Embedded Computer	E1498A
Delete SICL media and manuals	E1498A 002
64 MB total RAM	E1498A ANE
128 MB total RAM	E1498A ANS
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E1498A W01

Publication No.: 5965-6546E

GPIB and LAN Interfaces

Agilent 82341C, 82345G, 82350A, 82351G, 82353G,
E2050B, E2071C, E2071D, E2091, E2094



Agilent 82350A

- High-performance GPIB plug-in interface cards for PCs and HP-UX workstations
- Agilent I/O Libraries for SICL- and VISA-based applications
- Easy access and control of GPIB instruments
- Low-cost access to GPIB instruments over the LAN
- Automation Kits provide the tools you need in one convenient package

Description

Agilent Technologies offers a full line of products to connect your instruments to your computer. These interface cards and the accompanying software make it easy to access and control instruments, exchange data, and create your own automated test applications. These GPIB products include:

- GPIB interface hardware and software for PCs
- GPIB interface hardware and software for HP-UX workstations
- LAN/GPIB Gateway for low cost, remote access to GPIB instruments over LAN

Agilent also offers PC Automation Kits which combine the hardware, I/O software, and application software you need to automate your bench or test system at the best possible price.

Refer to the Agilent Technologies Website for more information.

High-Performance GPIB Interfaces

The low-cost, high-performance IEEE-488 interfaces make it easy to access and control your GPIB instruments and quickly automate tests. The GPIB interfaces come complete with hardware and software for either PCs or HP-UX workstations.

These cards are capable of 750 KB/s data rate with built-in buffering, providing system performance that is superior to direct memory access (DMA). The GPIB interfaces include the Agilent I/O Libraries software that allows you to work with software that is open and portable (such as Visual Basic, C/C++, and Agilent VEE), regardless of the I/O interface or computer platform.

GPIB interfaces for PCs plug into either an ISA or PCI slot in the backplane of your PC. The GPIB interface cards for HP-UX workstations plug into either an EISA or PCI slot in your workstation.

E2050B LAN/GPIB Gateway

The Agilent Technologies E2050B LAN/GPIB Gateway provides low-cost access to GPIB instruments over an existing LAN. It is a combination of hardware and the Agilent I/O Libraries software that allows for the use of existing SICL- or VISA-based applications over the LAN without modifying the application beyond a simple address change.

The gateway uses a client/server technology to extend the standard SICL/VISA functions to control GPIB instrumentation located remotely on the LAN. This gives you the opportunity to put your controller at an alternative, more convenient, or safer location. Therefore, you can go through the gateway instead of a GPIB interface card.

By using the standard LAN capabilities included on many PCs and workstations, instrument control can be driven from a computer that does not have a special interface for instrument control. Instruments can be shared over your existing network and systems.

Agilent I/O Libraries

The Agilent I/O Libraries for instrument control include SICL and VISA software. SICL (Standard Instrument Control Library) is Agilent's original implementation of an I/O Library Standard. As other manufacturers in the industry recognized the value of a standard I/O library for test and measurement, the VXIplug&play System Alliance was formed. VISA (Virtual Instrument Software Architecture) specification was developed as a standard for test and measurement by the VXIplug&play Systems Alliance. This standard ensures a high degree of interoperability among VXI vendors that provide mainframes and instruments, controllers and interfaces, and software.

The VISA specification is based on the most frequently used I/O function calls. The calls are similar to SICL calls—for example *iopen* in SICL is *viopen* in VISA. You can continue using existing SICL applications while adding VISA for new ones. There's also portability between Windows and HP-UX environments. Applications written on HP-UX run under Windows with a simple recompile of code.

The I/O Libraries software ships with any purchase of an Agilent GPIB product or Agilent VXI Slot 0 interface. It is also available for purchase as the E2094 I/O Libraries for Windows or E2091 I/O Libraries for HP-UX workstations.

	Interfaces for PCs		Interfaces for HP-UX Workstations	
	82341C	82350A	E2071C/D	E2078A
Description:	GPIB Interface for ISA bus on PC	GPIB Interface for PCI bus on PC	GPIB Interface for EISA bus on workstations	GPIB Interface for PCI bus on workstations
Operating system:	Windows 95/98/NT/2000	Windows 95/98/NT/2000/Me	HP-UX 9.x, 10.01, or 10.2	HP-UX 10.2
Agilent I/O Libraries:	SICL and VISA	SICL and VISA	SICL and VISA (HP-UX 9.x supported by SICL only, not VISA)	SICL and VISA
Backplane:	ISA	PCI	EISA	PCI (5-volt)
Maximum speed:	750 KB/s	750 KB/s	750 KB/s	750 KB/s
Buffering:	Built-in	Built-in	Built-in	Built-in
Supported languages:	Agilent VEE C/C++ HTBasic for Windows Visual Basic	Agilent VEE C/C++ HTBasic for Windows Visual Basic	Agilent VEE ANSI C BASIC/UX	Agilent VEE ANSI C C/C++ BASIC/UX

Note: The PC interface products listed above include the interface card, I/O software, and documentation.

The HP-UX workstation products listed above include the interface card, I/O software, GPIB cable, GPIB connection extender, and documentation.

(GPIB and LAN Interfaces continued)

PC Automation Kits with Agilent VEE Software and GPIB Cards

Agilent Technologies has combined its low-cost, high-performance IEEE-488 interface cards and I/O software with the powerful Agilent VEE graphical programming language to make configuring your system easier, and to make ordering more convenient—at the best possible price! These automation kits provide the hardware and application software necessary to easily access and control your GPIB instruments via your PC.

The kits include a high-performance GPIB card, the I/O software and instrument drivers, Agilent VEE, plus a 2-meter GPIB cable.

Select an automation kit with either an ISA or PCI GPIB card with high-performance 750 KB/s data rate with built-in buffering. The GPIB interfaces include the Agilent I/O Libraries software for instrument control. The GPIB interface card plugs into the backplane of your PC, and connects to GPIB instruments via a GPIB cable.

The automation kits also include your choice between the powerful graphical programming environment of Agilent VEE Pro or Agilent VEE OneLab, a subset of Agilent VEE Pro priced lower for standalone research and development applications.

For more information on Agilent VEE, see the Agilent VEE data sheet in the Development Software section of this publication.

	82345G	82351G	82353G
Description			
GPIB interface:	82341C ISA GPIB Interface	82350A PCI GPIB Interface	82350A PCI GPIB Interface
GPIB cable:	10833B 2-meter cable	10833B 2-meter cable	10833B 2-meter cable
Operating system:	Windows 3.1/95/NT/2000	Windows 95/98/NT/2000	Windows 95/98/NT/2000
Software:	Agilent VEE Pro	Agilent VEE Pro	Agilent VEE OneLab

For More Information

Visit the Agilent Technologies Website for more detailed information on Agilent's connectivity product selection, or request the following Data Sheets:

Agilent 82341C High-Performance ISA GPIB Interface for Windows, Pub No. 5966-2718E;

Agilent 82345G VEE Pro 6.0 PC ISA GPIB Automation Kit for Windows, Pub No. 5968-3924E;

Agilent 82350A High-Performance PCI GPIB Interface for Windows, Pub No. 5966-2720E;

Agilent 82351G VEE Pro 6.0 PC PCI GPIB Automation Kit for Windows, Pub No. 5968-0380EN;

Agilent E2050B LAN/GPIB Gateway, Pub No. 5965-5519E;

Agilent E2071B High-Speed GPIB Interface for S/700, Pub No. 5966-2859E;

Agilent E2071D High-Speed GPIB Interface for HP-UX 10.20 Workstations, Pub No. 5965-5518E;

Agilent E2078A PCI GPIB Interface for HP-UX Workstations, Pub No. 5968-1764E;

Agilent E2091 I/O Libraries for HP-UX Workstations, Pub No. 5965-5501E;

Agilent E2094 I/O Libraries for Windows, Pub No. 5965-5502E.

GPIB Interfaces Ordering Information

Description	Product No.
High-Performance PCI GPIB Interface	82350A
High-Performance ISA GPIB Interface for Windows	82341C
PCI GPIB Interface for HP-UX 10.20 Workstations	E2078A
High-Speed GPIB Interface for S/700	E2071C
High-Speed GPIB Interface for HP-UX 10.20 Workstations	E2071D

LAN/GPIB Gateway Ordering Information

Description	Product No.
LAN/GPIB Gateway	E2050B

I/O Libraries Ordering Information

Description	Product No.
I/O Libraries for HP-UX Workstations	E2091
I/O Libraries for Windows	E2094

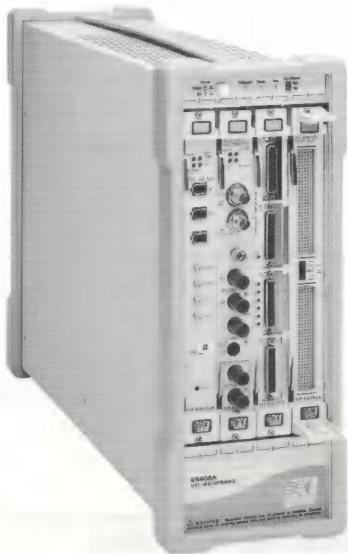
Automation Kits Ordering Information

Description	Product No.
VEE Pro 6.0 PC ISA GPIB Automation Kit	82345G
VEE Pro 6.0 PC PCI GPIB Automation Kit	82351G
VEE OneLab PC PCI GPIB Automation Kit	82353G

GPIB Cables Ordering Information

Description	Product No.
GPIB Cable, 1 meter (3.3 ft.)	10833A
GPIB Cable, 2 meter (6.6 ft.)	10833B
GPIB Cable, 4 meter (13.2 ft.)	10833C
GPIB Cable, .5 meter (1.6 ft.)	10833D
GPIB Cable, 8 meter (26.4 ft.)	10833G
GPIB to GPIB Adapter	10834D

Agilent E8408A
Low-Cost 4-slot
C-Size VXI Mainframe
(with modules installed)



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B-Size Mainframes

Product No.	Description
E1300B	B-Size VXI Mainframe, 9-Slot
E1301B	B-Size VXI Mainframe, 9-Slot

C-Size Mainframes

Product No.	Description
E1401B	13-Slot Mainframe, Low Profile
E1421B	6-Slot Mainframe, High Power
E8401A	13-Slot Mainframe, 500 W, Low Cost
E8403A	13-Slot Mainframe, 1000 W, Low Cost
E8404A	13-Slot Mainframe, 1000 W, Enhanced Monitoring
E8408A	4-Slot Mainframe, 175 W, Low Cost

Introduction

Agilent Technologies leads the test system industry with B- and C-size VXI mainframes designed for high-performance system power, superior cooling and enhanced monitoring. All these features deliver system reliability, high uptime, and confident measurements.

The E8408A 4-slot, C-size mainframe is a lightweight and portable enhancement to Agilent's C-size mainframe family. It is priced well below the other Agilent VXI C-size mainframes and brings down the cost of test, especially when combined with Agilent's multifunction VXI M-Modules and data acquisition modules. The C-size E8401/03/04A 13-slot mainframes have enhanced cooling, accommodating higher-power VXI modules. Enhanced cooling is a breakthrough technology with higher-performance fan (impeller) design for superior cooling and less noise.

Overview: Mainframe Choices

The E8408A 4-slot mainframe is the smallest and lightest-weight C-size mainframe. Its small size saves system rack space. Small size and light weight make the E8408A transportable and suitable for many data acquisition and field service applications.

The E8401A C-size mainframe, with 500 watts of usable power, is the lowest-priced 13-slot mainframe in the Agilent E8401/03/04A family and leads the industry in price/performance. The E8403A has all the features of the E8401A plus 1000 watts of usable power for those applications requiring high-power VXI modules.

The E8404A (1000 watts of usable power) comes with enhanced VXI mainframe monitoring features. A key advancement is the menu-driven, full color, liquid-crystal display on the front of the mainframe for checking temperatures, voltages, currents, power, and fan speeds. In addition, the display shows system messages, warnings, usage history, maintenance timer, and RS-232 settings.

High-performance test applications needing fewer VXI modules can use the E1421A 6-slot, C-size mainframe. This compact mainframe with ultra-reliable power supply and pressurized air channel cooling, is ideal for portable or rack-mount testing applications.

Agilent's B-size mainframes provide high quality VXI mainframes for cost-effective solutions. The E1300B/01B 9-slot, B-size mainframes have dual fan cooling which improves performance and extends the life expectancy of VXI cards. These higher-performance mainframes support more demanding B-size modules, such as multimeters and Mezzanine Modules (M-Modules). The 9-slot mainframes come with a built-in GPIB interface for communication to an external computer.

Family Specifications

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B-Size Mainframes

Model	E1300B	E1301B
	VXI Mainframe	VXI Mainframe
VXI Characteristics		
Compliance:	VXI Rev 1.4	VXI Rev 1.4
Size:	B	B
Slots:	9	9
Connectors:	P1	P1
Specifications		
Usable power:	120 W @ 40° C	120 W @ 40° C
Power input voltage range:	115/230 Vac nom.	115/230 Vac nom.
Power input frequency range:	50/60/400 Hz nom.	50/60/400 Hz nom.
Cooling/slot (typ. use):	25 W	25 W
Acoustic noise:	48 dBa	48 dBa
Features		
Embedded GPIB Slot 0:	Yes	Yes
Keyboard/display:	No	Yes

C-Size Mainframes

Model	E1401B	E1421B	E8401A	E8403A	E8404A	E8408A
VXI Characteristics						
Compliance:	VXI Rev 1.4	VXI Rev 1.4	VXI Rev 1.4	VXI Rev 1.4	VXI Rev 1.4	VXI Rev 1.4
Size:	C	C	C	C	C	C
Slots:	13	6	13	13	13	4
Connectors:	P1/P2	P1/P2	P1/P2	P1/P2	P1/P2	P1/P2
Specifications						
Usable power, 0-55° C:	650 W	450 W	500 W	1000 W	1000 W	0 - 40° C 175 W 40 - 50° C 150 W 50 - 55° C 125 W
Power input voltage range:	100/240 Vac nom.	100/240 Vac nom.	90 - 264 Vac	90 - 264 Vac	90 - 264 Vac	90 - 264 Vac
Power input frequency range:	50/60/400 Hz nom.	50/60/400 Hz nom.	47-66 Hz	47-66 Hz	47-66 Hz	47 - 400 Hz
Cooling/slot (typ use):	75 W	75 W	100 W	100 W	100 W	70 W
Cooling/slot, per VXI-8:	55 W	55 W	75 W	75 W	75 W	55 W
Acoustic noise (on low fan speed):	48 dBa	53 dBa	42 dBa	42 dBa	42 dBa	<40 dBa
Features						
Diagnostic connector:	Yes	Yes	Yes	Yes	Yes	No
Standard monitor:	No	No	Yes	Yes	Yes	Yes
Enhanced monitor:	No	No	No	No	Yes	No

VXI Mainframes, 13-Slot C-Size, 500 & 1000 Watt

Agilent E8401A, E8403A, E8404A



Agilent E8404A

- 13-Slot, C-size,
- 500 – 1000 watts of usable power
- Efficient, quiet cooling improves VXI module performance
- Range of mainframe monitoring capabilities for confident measurements
- Compliant with VXIbus and VXIplug&play Specifications

Description

The Agilent Technologies E8400 Series of 13-slot, C-size VXI mainframes provides a wide range of mainframe solutions to meet all your test system needs. They deliver innovative cooling technology, improved backplane design, high reliability, easy maintenance, and versatile accessories. The innovative air distribution system used in all three mainframes provides extremely quiet and efficient cooling.

Selection Guide

	E8401A	E8403A	E8404A
Description:	Lowest-cost, moderate-power mainframe	Lower-cost, high-power mainframe	High-performance mainframe
Number of slots:	13	13	13
Usable power:	500 W	1000 W	1000 W
Monitoring:	Basic	Basic	Enhanced

The power supply in the E8401A VXI mainframe provides 500 watts of usable power, sufficient for most automated test applications. The power supply in the E8403A and E8404A VXI mainframes provides 1000 watts of usable power, sufficient for the most demanding automated test applications. Ample dynamic and peak current capability is provided for most applications.

The basic mainframe monitoring of the E8401A and E8403A indicates normal operating conditions at a glance. The enhanced monitoring of the E8404A mainframe provides superior cooling control and details regarding temperatures throughout the mainframe, power supply voltages and currents, fans operation, system status, history queue, and stripcharts or histograms for easy diagnostics. This information is available on the full color display or through VXIbus or RS-232 connection. A front panel diagnostics connector on all three mainframes allows continuous local or remote system monitoring.

These mainframes comply with the VXI Specification by providing injector surface rails used by the QUIC easy module insertion and extraction system. Superior cooling, reliable design and system monitoring make any of these mainframes an excellent choice for all VXI test system applications.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Superior Cooling

The innovative cooling design of these three VXI mainframes provides extremely quiet and efficient cooling. Carefully engineered airflow provides the ultimate in cooling with a minimum of noise. Outstanding back pressure performance insures airflow through dense modules. Separate power supply cooling fan(s) provides an independent air path for reliable cooling of the power supply.

For all three mainframes, all fans operate in either Variable or Full Speed mode. A two-position switch on the mainframe's front panel controls the speed mode. Full Speed mode is recommended for maximum cooling and/or if acoustic noise is not a concern; all air movers (cardcage impeller and power supply fan(s)) operate at full capacity at all times. In Variable Speed mode, the fan speed varies depending on the temperature in the mainframe, and the ambient temperature. Variable Speed mode operation allows the quietest operation while providing sufficient cooling for the modules in the mainframe.

Airflow is conveniently routed into the rear and exhausted out the sides of the mainframe. This allows mainframes to be stacked or rack-mounted directly on top of one another.

Improved, Highly Reliable Backplane Design

The backplane of all three mainframes features solid state automatic daisy-chain jumpering for the VMEbus grant and interrupt acknowledge lines, eliminating the need for hand selection of switch settings. Full differential distribution of the CLK10 signal is provided on the backplane. This minimizes jitter and skew, providing a clean timing source for VXI instrument modules. The surface mount backplane improves both reliability and stripline signal performance.

Agilent generates SYSRESET and ACFAIL on the backplane. This is necessary for full compliance with the VXI Specification, but is not generally implemented by other manufacturers.

Easy Maintenance Rear-Accessible Power Supply and Impeller

Convenient access to the power supply and cooling systems of all three mainframes, and the monitoring system of the E8404A, is provided through the mainframe's rear panel. A replacement power supply or fan can be installed without removing the mainframe from a rack. The power supply's plug-in design makes repair easy.

The E8404A monitor control board and the impeller for module cooling are easily replaced. The internal fan for the power supply, an integral part of the supply, is easily replaced with the power supply itself. If the optional Air Filter Accessory Kit is installed, air filters may be replaced without tools.

At-a-Glance Confidence in Operation

The front panel indicator lights on all three VXI mainframes give immediate visual indication that the power supply voltages are operating within the VXI Specification, the temperatures are within limit, and that the fans are operational. Backplane activity and SYSFAIL indicators are also provided.

The system can be reset easily from the front panel of all three mainframes, providing reset even when the Slot 0 is inaccessible due to cabling.

The diagnostic connector, conveniently located on the front of all three mainframes, provides connection for remote monitoring of power supply voltages, power supply and reference temperatures, and fans function. This connector also allows remote on/standby, access to +5VSTDBY, ACFAIL, and SYSRESET. The connector's functionality is a superset of the functionality on the E1401B mainframe, allowing software and hardware compatibility with existing applications. Up to 1 A of +5VSTDBY may be provided by the user through the connector. Up to 1 A each of +5 V and +12 V are available for external applications through the connector.

E8404A Enhanced Monitoring

- VXIbus or RS-232 communication
- Three temperature sensors per slot
- Cooling control
- Power supply voltage and current
- Stripcharts and histograms for easy diagnostics
- Audible warnings of over-limit conditions
- History queue
- VXIplug&play WIN Framework driver
- English, French, German, and Spanish language support

(Agilent E8401A, E8403A, E8404A continued)

State-of-the-art enhanced monitoring is provided on the E8404A VXI mainframe. The enhanced monitor board plugs into the backplane from the rear of the mainframe; it does not occupy a slot in the mainframe or tie up a MODID line.

The E8404A enhanced monitoring is message based, allowing easy communication with the mainframe for the user over RS-232 or through the VXIbus. SCPI commands are used to address the mainframe. A *VXIplug&play* WIN Framework driver is provided.

On the E8404A, temperature monitoring includes module exhaust temperatures at three points on every slot, power supply temperature and ambient temperature. Measurements at the front, center and rear of every slot provide an accurate assessment of the temperature fluctuations over a variety of cards, whose hottest components may vary in position. Display screens are provided for overall temperature map, temperature limits set, stripcharts and histograms of each slot.

E8404A temperature monitoring is also used for cooling control. Both the absolute temperature of the slots and the temperature rise over ambient temperature are measured. Cooling speed is increased when either an absolute temperature or a temperature rise approaches its respective limit. The user may adjust these control limit ranges programmatically.

Speeds of the E8404A power supply fans and the impeller are displayed as a percentage of full speed and as the number of rotations per minute.

All seven voltages, +5VSTDBY and the optional user-supplied external 5 V power are measured on the E8404A. Current monitoring is provided and power is calculated for each power supply voltage. Overview display screens are provided for all these data; more detailed information is also available in stripcharts and histograms. These values are visible on the display and are available through the VXI and RS-232 interfaces.

On the E8404A, warning alarms occur when a temperature is over limit, power supply voltages are out of VXI specification, when current or total power exceeds user set limits, or for certain user-defined conditions. A beeper provides audible warnings; it is enabled or disabled through a SCPI command or through the front panel keys.

The enhanced monitor includes a maintenance timer. This timer may be set, queried, and reset by the user for support of scheduled maintenance activities, such as cleaning the optional air filter.

The enhanced monitor may operate independently of line power by using an external +5 V power supply. When line power goes down, communication with the enhanced.

With the E8404A, a remote power-on signal is available via the diagnostic connector's "remote on signal" or through a SCPI command.

Localization enables the user to select English, French, German, or Spanish languages on the display for ease of operation worldwide.

E8404A Color Graphics Display

A full color graphical display on the front of the E8404A VXI mainframe provides frame status, including:

- Temperatures at front, center and rear of every slot
- Ambient and power supply temperatures
- Power supply voltages
- Power supply currents
- Total power
- Fans speeds
- User-defined text messages
- System log and timer
- History

Accessories and Configurations

(Applicable to all three mainframes)

Optional Rack Mounting Kits

Three rack mounting kits are available for the mainframe, providing versatile options for installation in an Agilent or non-Agilent rack. The following rack mounting kits are available: Standard Adapter Kit, Flush Mount Adapter Kit and *VXIplug&play* Compliant Adapter Kit.

Standard Adapter Kit for Recess, Flush or Forward Rack Mounting

Using the Standard Adapter Kit (E8394A), the mainframe can be recess mounted up to 10.6 inches in ~1/2 inch increments. (Recess mounting is required for compatibility with the tinted acrylic door.) The mainframe can also be mounted extended from the front of the rack from 0 to 5.8 inches in ~1/2 inch increments, allowing mounting in racks with shallow depths. The Standard Adapter Kit includes handles and requires the E3664AC Support Rail Kit or the 1494-0411 Rack Slide Kit.

Flush Mount Adapter Kit

The Flush Mount Adapter Kit (Opt. 924 or E8400-80924), the least expensive of the adapter kits, allows flush rack mounting of the mainframe. It does not include handles. The Flush Mount Adapter Kit requires the E3664AC Support Rail Kit. The Flush Mount Adapter Kit is not compatible with the tinted acrylic door or with the rack slides.

VXIplug&play Compliant Adapter Kit

The *VXIplug&play* Compliant Adapter Kit (Opt. 925 or E8400-80925) provides rack mounting compatible with the *VXIplug&play* VPP-8 Specification for ease of interconnect with MAC Panel, Virginia Panel, TTI Testron or other *VXIplug&play*-compatible ICA receivers. The Adapter Kit locates the mainframe in the position prescribed by the *VXIplug&play* Systems Alliance and provides four mounting holes for attachment of the receiver adapter frame. The *VXIplug&play* Compliant Adapter Kit requires the E3663AC Support Rail Kit or the 1494-0411 Rack Slide Kit.

Electromagnetic Compliance (EMC) Accessories

The standard mainframe is suitable for the majority of applications. However, for EMC-sensitive applications, a Chassis Shield Kit, Backplane Connector Shields, and EMC Filler Panels are available.

Chassis Shield Kit

The Chassis Shield Kit (E8400-80919) is used to provide additional isolation or shielding between noisy or sensitive modules. These newly designed, patent pending chassis shields are easy to install and are grounded in all four corners.

Backplane Connector Shields

Backplane Connector Shields (Opt. 918 or E8400-80918) are useful for improving the ground connection between a module and the backplane. For a few modules, they are necessary for EMC compliance to EN55011 and CISPR11. For the vast majority of modules, they are not necessary. Note that these shields are only useful if the module includes contacts conforming to VXI Spec B.7.2.3.

EMC Filler Panels

EMC Filler Panels (E8400-60202) are used to provide a continuous connection across the front opening of the mainframe. All Agilent modules include EMC contacts to the adjacent slot. Using EMC Filler Panels in the empty slots completes the connection and reduces radiated emissions and increases radiated and ESD immunity.

Optional Air Filter

Air filters are not necessary on these mainframes. However, an optional Air Filter Kit (E8395A) is available for use in demanding environments. The airflow is reduced less than 10% with a clean air filter installed.

Cable Routing

In rack-mount installations, cables can be routed to the front of the mainframe or from below the mainframe. The optional Cable Tray (E8393A) allows cable routing under the mainframe. The Cable Tray may be mounted to provide three different heights: one EIA rack unit (44.5 mm), two EIA rack units, and halfway between one and two EIA rack units. It is compatible with the E3664AC Support Rail Kit and the 1494-0411 Rack Slide Kit. If the mainframe is used on a benchtop, the mainframe feet may be removed and reinstalled on the bottom of the Cable Tray.

Optional Door

An optional Tinted Acrylic Door (Opt. 915 or E8400-80915) is available for use in rack-mount installations. All the modules installed in the mainframe are accessible when this door is open. The door hinges on the right so that its latch mechanism occupies the space outside Slot 0, allowing the door to close with the minimum recess into the rack. Its hinges are a lift-off type so that the door may be easily removed when open. The door is fabricated of acrylic to provide adequate strength and superior scratch resistance when compared to polycarbonate. The Tinted Acrylic Door Kit requires and is compatible with the Standard Adapter Kit (E8394A) only.

Documentation

The mainframe documentation consists of a User and Service Manual that is included with the mainframe. The manual is also distributed on the Agilent Universal Instrument Drivers CD-ROM supplied with the mainframe and a variety of other Agilent VXI products. It is also available on the Agilent Technologies Website. This documentation describes all mechanical aspects for the mainframe and its accessories.

Warranty

Agilent Technologies provides a standard 3-year return-to-Agilent warranty on these mainframes. Opt. W01 converts the standard warranty to 1-year on-site.

(Agilent E8401A, E8403A, E8404A continued)

Product Specifications

Mechanical

Mainframe height:	352 mm (13.9 inches)(8 EIA rack units)
Mainframe width:	424.5 mm (16.7 inches)
Mainframe depth:	631 mm (24.9 inches)
Mainframe weight, E8401/03A:	24 kg (53 lbs.)
Mainframe weight, E8404A:	25 kg (55 lbs.)

Power

	E8401A	E8403A/E8404A
Temperature range:	0-55° C	0-55° C
Available power (90-264 Vac):	686 W	1902 W
Usable power (110-264 Vac):	500 W	1000 W
Usable power (90-110 Vac):	500 W	950 W

Available Current

Voltage	E8401A		E8403A/E8404A	
	Peak Current I_{MP} (Amps) @ 55° C:	Dynamic Current I_{MD} (Amps) @ 55° C:	Peak Current I_{MP} (Amps) @ 55° C:	Dynamic Current I_{MD} (Amps) @ 55° C:
+5 V:	50 A	5 A	90 A	9 A
+12 V:	6 A	1 A	15 A	2.5 A
-12 V:	4 A	1 A	15 A	2.5 A
+24 V:	4 A	1 A	15 A	5 A
-24 V:	4 A	1 A	15 A	5 A
-5.2 V:	20 A	2 A	60 A	8 A
-2 V:	10 A	1 A	30 A	5 A

Power Input

Input voltage:	90-264 Vac (single continuous range)
Input frequency:	47-66 Hz (across full input voltage range) 360-440 Hz: Not recommended. Leakage currents may exceed safety limits, 132 Vac max.
DCV input:	Not recommended. Input connector is not certified for DCV input.

Inrush current

	E8401A	E8403A/E8404A
100 Vac input:	25 A typ.	40 A typ.
264 Vac input:	55 A typ.	70 A typ.

Power Switch

- On/Standby switch on front with lighted indicator.
- May be switched to On/Standby remotely via diagnostic connector (E8404A only).
- May be switched to On/Standby via SCPI command (E8404A only).

+5VSTDBY

(Power may be provided by the user to the +5VSTDBY bus on the VXI backplane.)

Current:	1 A max
Voltage range:	5.25 V max., 4.875 V min.
Connector:	Pins 8 and 21 of the diagnostic connector

External +5VSTDBY (E8404A only)

(Power may be provided by the user to operate the enhanced monitor in the absence of line power.)

Current:	500 mA min. (needed for enhanced monitor operation), 1.5 A max. on connector.
Voltage range:	5.25 V max., 4.875 V min.
Connector:	Rear panel

Power Supply Protection

All voltages are protected from over-temperature, over-voltage, over-current, short-to-ground and short-to-other-output. Protection mode is full shutdown. Recovery occurs when the fault condition is removed and power on/standby is cycled.

Airflow and Cooling

Airflow

Airflow is routed into the rear and exhausted out the upper sides of the mainframe. Allow 50 mm of clearance for proper air flow.

Fan Speed

(Cooling Mode, High or Variable, switchable on the front panel. Controls both module impeller and power supply fan.)

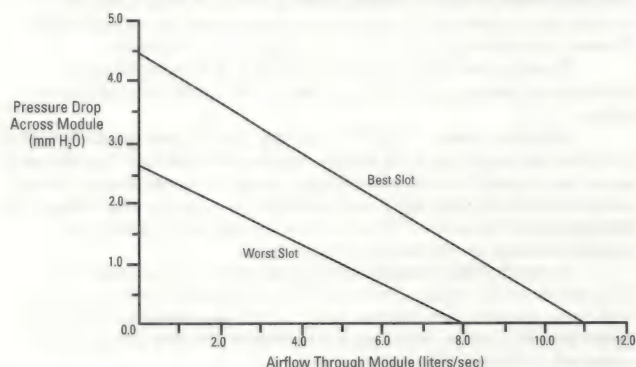
High fan speed mode:

Full airflow all the time

Variable fan speed mode:

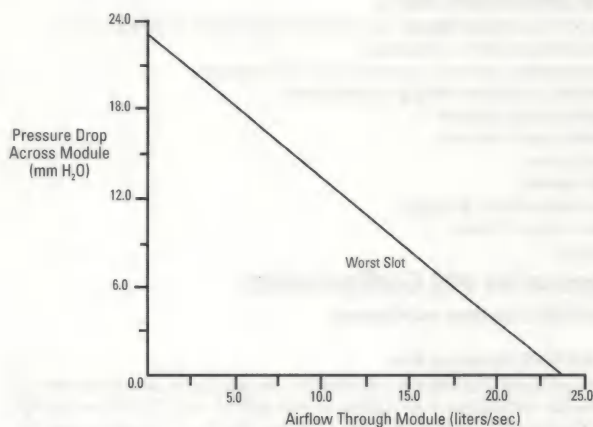
Fan speed increments through 8 discrete speeds as a function of ambient, module, and power supply temperatures.

E8401A/03A/04A Cooling Specification Charts



VXI-8 Specification Draft 2.0, Fixture revision 1.7.

- VXI-8 Standard Modules installed in all other slots.
- Performance shown for Worst Slot (slot 1) and Best Slot (slot 10).
- Front-to-Rear Variance 13% worst case. Typically 10%-12% in most slots.
- Fans on Full Speed. Minimum airflow is approximately 50% with fans on Variable Speed.
- Air Filter Kit not installed. Airflow is reduced approximately 10% with clean air filters installed.
- Measurements taken at 1,500 m altitude.



All other slots blocked. Airflow decreases as additional slots are opened.

- Performance shown for Worst Slot (slot 2). Airflow is greater in all other slots.
- Fans on Full Speed. Minimum airflow is approximately 50% with fans on Variable Speed.
- Air Filter Kit not installed. Airflow is reduced approximately 10% with clean air filters installed.
- Measurements taken at 1,500 m altitude.

(Agilent E8401A, E8403A, E8404A continued)

Backplane Specifications

- Solid-state automatic daisy-chain jumpering for BUS GRANT and IACK signals.
- Full differential distribution of CLK10.
- ACFAIL* and SYSRESET* in full compliance with the VMEbus and VXibus Specifications.
- Surface mount construction and no sockets for maximum reliability.

Environmental**Temperature**

Operating temperature range: 0° C – +55° C
Storage temperature range: –40° C – +75° C

Humidity

Operating humidity range: Up to 95% RH from 0° C to +40° C
Up to 65% RH from +40° C to +55° C
Storage humidity range: Up to 95% RH from 0° C to +55° C
Up to 65% RH from +55° C to +75° C

Acoustic Noise

(Sound power at bystander position one meter in front of mainframe)

High-speed fan: 55 dBA
Variable fan on low speed: 42 dBA

Shielding

Front panel EMC gasketing: Front panel gasketing provided per VXI Rev. 1.4, B.7.2.3
Backplane shielding: Backplane connector shields per VXI Rev. 1.4, B.7.2.3
Intermodule chassis shielding: Intermodule chassis shields per VXI Rev. 1.4, B.7.3.4

Altitude: Up to 3000 m

Standards Compliance

- 100% compatible with the VXibus Specification Revision 1.4
- E8404A command set compatible with IEEE-488.1, IEEE-488.2, and SCPI-1995.0

Repair

(Diagnosis and troubleshooting through the front panel monitor and connector.)

MTTR = Mean Time to Repair

MTTR, power supply: <10 min. (w/mainframe and modules fully installed in rack)

MTTR, impeller and/or fan: <10 min. (w/mainframe and modules fully installed in rack)

MTTR, E8404A enhanced monitor control board: <5 - 10 min. (w/mainframe and modules fully installed in rack)

General Specifications**VXI Characteristics**

VXI device type: Mainframe
Data transfer bus: All per VXibus Specification, Rev 1.4
Size: C
Slots: 13 available
Connectors: P1/P2
Shared memory: n/a
VXI buses: All per VXibus Specification, Rev 1.4

E8404A Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: n/a
Command module firmware rev: n/a
I-SCPI Win 3.1: n/a
I-SCPI Series 700: n/a
C-SCPI LynxOS: n/a
C-SCPI Series 700: n/a
Panel Drivers: No
VXIplug&play Win Framework: No
VXIplug&play Win 95/NT Framework: Yes
VXIplug&play HP-UX Framework: No

**Basic Monitor Specifications
(Applicable to all three mainframes)**

Indicators:

- Power-on or Standby status
- Power supply output voltages monitor
- Power supply temperature monitor
- Fans status monitor
- Backplane activity monitor
- Backplane SYSFAIL monitor

Switches:

- On/Standby
- Fan Mode: Switches all fans between Full Speed and Variable Speed modes
- Reset: Asserts backplane signals SYSRESET and ACFAIL

Diagnostic connector:

- Output all 7 backplane voltages for monitoring
- Output +5 V and +12 V for remote applications. 1A max each
- Input +5VSTDBY to backplane. 1A max total for pins 5 and 18
- Remotely operate On/Standby
- Power supply temperature output
- Reference temperature output
- Fans OK output, same as Fans indicator
- Backplane voltages OK output
- SYSRESET*, input or output
- ACFAIL*, output
- Ground

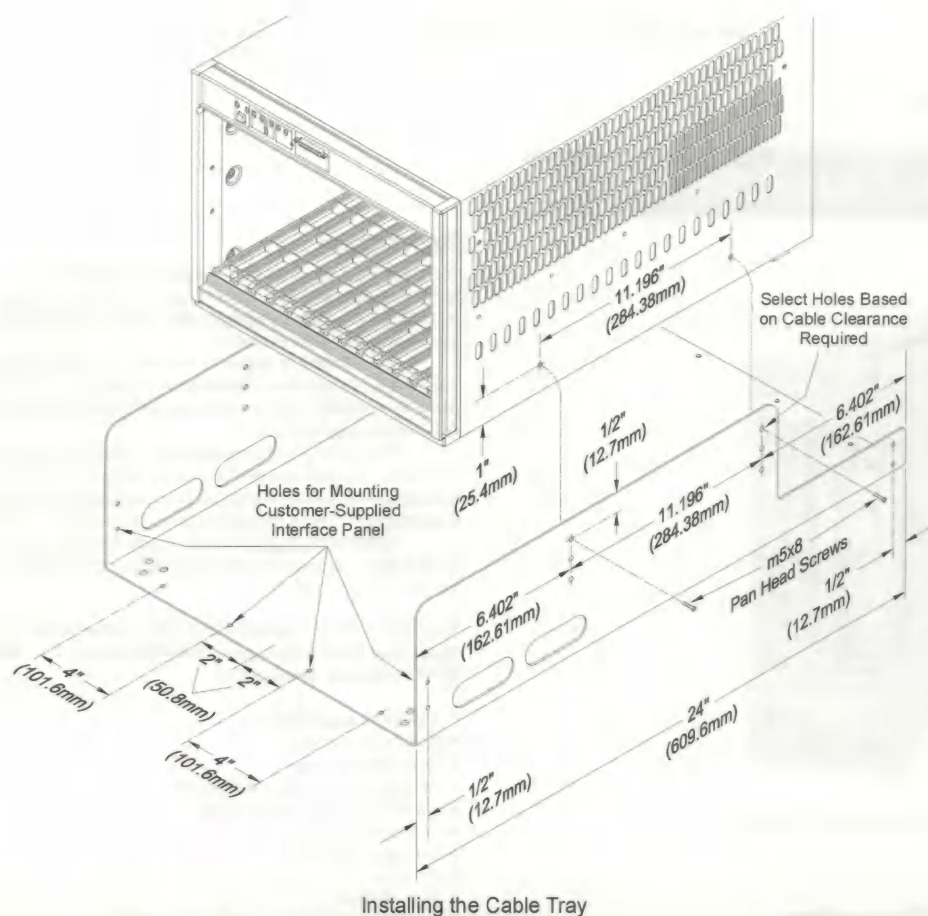
(Agilent E8401A, E8403A, E8404A continued)

E8404A Enhanced Monitoring

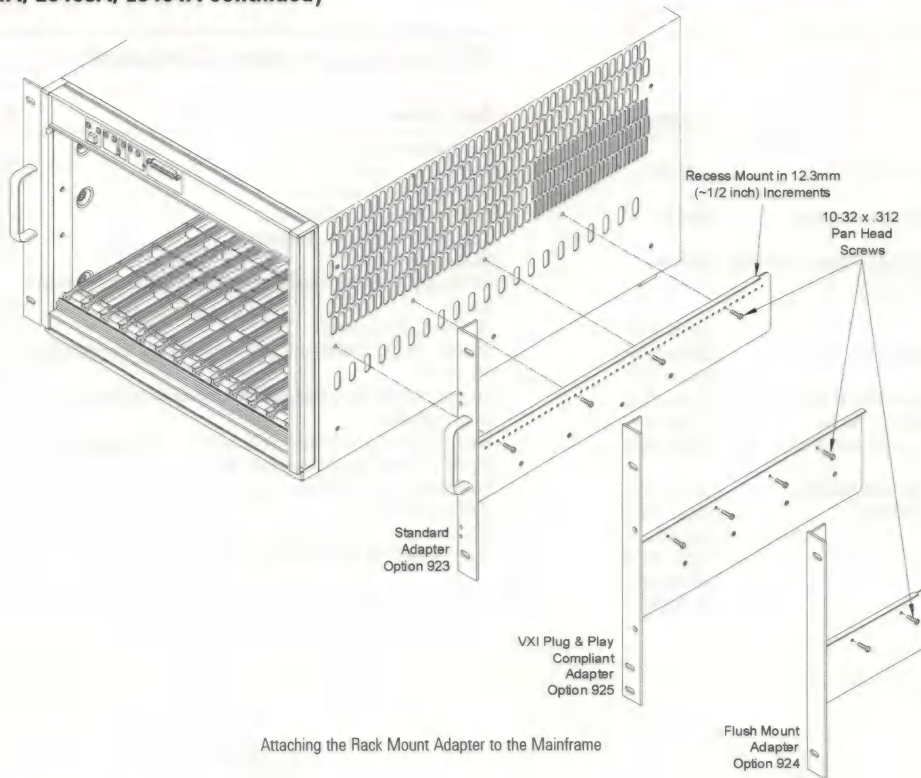
	Function	Specification	Display	Interface VXI	RS-232
Temperature Monitor	Module exhaust temperature:	13 slots, front/mid/rear	Output	Output	Output
	Ambient temperature:		Output	Output	Output
	Power supply temperature:		Output	Output	Output
	Temperature limits:	Module absolute, ΔT , ambient	Output	In/Out	In/Out
	Stripcharts:	Modules, ambient	Output	Output	Output
	Histograms:	Modules, ambient	Output	Output	Output
	Warnings:	Out-of-limit conditions	Output	Output	Output
Power Monitor	Voltages:	7 VXI, 5VSTDBY	Output	Output	Output
	Current:	7 VXI	Output	Output	Output
	Power:	Calculated (V*I)	Output	Output	Output
	Voltage Limits:	Fixed		Output	Output
	Current Limits:	7 VXI	Output	In/Out	In/Out
	Power Limits:	Total	Output	In/Out	In/Out
	Stripcharts:	7 VXI, 5VSTDBY, total, PSTemp	Output	Output	Output
	Histograms:	7 VXI, 5VSTDBY, total, PSTemp	Output	Output	Output
Fan Monitor	Warnings:	Out-of-limit conditions	Output	Output	Output
	Fan speed: % full, RPM	Module impeller, PS fans	Output	Output	Output
	Stripcharts: RPM	Module impeller, PS fans	Output	Output	Output
	Histograms: RPM	Module impeller	Output	Output	Output
	Fan speed control:	Closed loop control in Var mode			
History	Warnings:	Out-of-limit conditions	Output	Output	Output
	System log:	Hrs on, last cal, etc.	Output	Output	Output
	Maintenance timer:		Output	In/Out	In/Out
	History queue:	Event description & time	Output	Output	Output
	Min/max values:	Temperature, power supply, fans		Output	Output
Time Base	Histograms:	Temperature, power supply, fans	Output	Output	Output
	Accuracy:	± 120 ppm			
	Aging:	± 5 ppm/year			
Test & Calibrate	Resolution:	2 sec			
	Calibration:	Temperature, voltage		Input	Input
VXI	Self-test:		Output	In/Out	In/Out
	VXI device type:	Message-based servant, programmable-interrupter, statically-addressed, A16 device			
RS-232 Interface	LADD:	Rear panel switch	Output	Output	Output
	Device code:	618		Output	Output
	Baud rate:	300, 1200, 2400, 4800, 9600	Output	In/Out	In/Out
Display	Parity:	Even, Odd, None	Output	In/Out	In/Out
	Character size:	7,8	Output	In/Out	In/Out
	Pace:	Xon/Xoff, None	Output	In/Out	In/Out
	Hardware handshake:	RTS	Output	In/Out	In/Out
	Resolution:	256 x 64 pixels			
Display	Colors:	16			
	Type:	Liquid Crystal Display			
	Size:	92mm x 25mm			
	Average bulb life:	25,000 hours			
	Language support:	English, French, German, Spanish			
	User-defined messages:	200 characters, 4 lines max	Output	In/Out	In/Out
	Display contrast:		In/Out		
	Screen saver On/Off:		In/Out	In/Out	In/Out
	Beeper On/Off:		In/Out	In/Out	In/Out

Ordering Information (Continued)

Description	Product No.
Accessories (Continued)	
EMC Filler Panel (1-slot)	E8400-60202
VXI Slot Filler Panel (1-slot)	E8400-44305
VXI Slot Filler Panel (3-Slot)	E8400-44306
Standard Rack Mount Adapter Kit	E8394A
Flush Rack Mount Kit	E8400-80924
<i>VXIplug&play</i> (VPP-8) Compatible Rack Mount Kit for Agilent Racks	E8400-80925
Air Filter Accessory Kit	E8395A
Support Rail for Standard Rack Mount Adapter or Flush Rack Mount Kit	E3664AC
Support Rail Kit for <i>VXIplug&play</i> (VPP-8) Rack Mount Kit (used w/E8397A)	E3663AC
Rack Slide Kit for Standard Adapter Kit or <i>VXIplug&play</i> (VPP-8) Compatible Rack Mount Kit	1494-0411
Replacement 500 W Power Supply for E8401A (Remanufactured)	E8401-69276
Replacement 1000 W Power Supply for E8403A/E8404A (Remanufactured)	E8403-69277



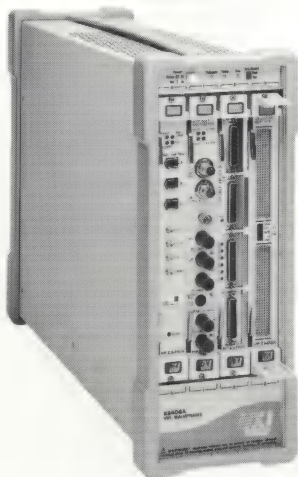
(Agilent E8401A, E8403A, E8404A continued)



Publication No.: 5988-2342EN

VXI Mainframe, C-Size, 4-Slot, 175 Watt

Agilent E8408A



Agilent E8408A with modules installed

- 4-Slot, C-size
- Agilent's lowest-priced VXI C-size mainframe
- Small size/light weight opens new applications for VXI
- Basic mainframe monitoring increases measurement confidence
- Efficient, quiet cooling improves performance
- Compliant with VXIbus Specifications

Description

The E8408A, Agilent's 4-slot C-size VXI mainframe, is priced well below other Agilent VXI C-size mainframes. Its low price brings down the cost of test, especially when combined with Agilent's multi-function VXI M-Modules and data acquisition modules.

The E8408A is Agilent's smallest and lightest-weight C-size mainframe. Its small size saves system rack space. Small size and light weight make the E8408A transportable and suitable for many data acquisition and field service applications.

The E8408A offers mainframe monitoring, quiet efficient cooling, and 175 watts of usable power. Front panel monitor lights give up-to-the-moment indication that power supply and fan are operating and that the internal temperature is OK. A two-speed fan provides quiet, powerful cooling.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Visit Agilent Technologies' worldwide websites (<http://www.agilent.com/find/vxi> or <http://www.agilent.com/find/tmdir>) to review the following E8408A example applications:

- Appliance manufacture
- Battery manufacture
- Cable and wire test
- Canning process characterization
- Crystal oscillator manufacture
- Design verification using environmental chambers
- Energy conservation
- Elevator test
- Race car test
- Switch box in Electronic Functional Test
- Wastewater treatment/test

(Agilent E8408A continued)**175 Watts Usable Power**

The E8408A provides 175 watts usable power. This is adequate to power the vast majority of Agilent VXI modules.

Superior Cooling

The E8408A's innovative mechanical design provides extremely quiet and efficient cooling for the power supply and modules. Carefully engineered airflow provides excellent cooling with minimum acoustic noise.

A two-speed cooling fan provides reliable cooling of the power supply and modules. The fan operates in either Variable (automatically controlled) or Full Speed mode. A two-position switch on the mainframe's front panel controls the speed mode. Full Speed mode is recommended for maximum cooling when acoustic noise is not a big concern. In Variable Speed mode, the fan speed is controlled automatically as a function of temperature rise in the mainframe and ambient temperature. Variable Speed mode allows the quietest operation while providing sufficient power supply and module cooling.

Airflow enters the mainframe rear panel, flows through the power supply, fan and modules and exhausts out the left side (as viewed from the front with the E8408A in horizontal position). This allows mainframes to be stacked or rack-mounted directly on top of one another.

At-a-Glance Confidence in Operation

The E8408A front panel indicator lights give up-to-the-moment visual indication that power supply voltages are operational, the power supply temperature is within limits, and the fan is operational.

Improved, Highly Reliable Backplane Design

The backplane features solid state automatic daisy-chain jumpering for the VMEbus grant and interrupt acknowledge lines, eliminating the need for hand selection of switch settings. Full differential distribution of the CLK10 signal is provided on the backplane. This minimizes jitter and skew, providing a clean timing source for VXI instrument modules. The surface mount backplane improves both reliability and stripline signal performance.

Agilent generates SYSRESET and ACFAIL on the backplane. This is necessary for full compliance with the VXI Specification, but is not generally implemented by other manufacturers.

Easy Maintenance Power Supply

Convenient access to the power supply and cooling fan is provided through the mainframe's rear panel. A replacement power supply and fan can be installed without removing the mainframe from your rack. The power supply's plug-in design makes replacement easy.

Accessories and Configurations**Backplane Connector Shields Kit**

The E8408A Opt 918 improves ground connections between VXI modules and the E8408A backplane. A few Agilent VXI modules require these shields to comply with EMC EN55011 and CISPR11. (The vast majority of Agilent VXI modules do not require these shields.) Note that the shields are only useful if VXI modules include contacts that conform to VXI Spec. B.7.2.3.

Rack Mount/Cable Route Kit

The E8397A Rack Mount Adapter Kit allows the E8408A to be flush-mounted or recess-mounted up to 8 inches in one-inch increments. In addition, the rack mount kit includes a 1.125-inch-wide cable route on the mainframe's right side, plus stick-on labels for use when the mainframe is mounted in a horizontal position. To mount the E8408A in Agilent rack cabinets, order the E8397A Rack Mount Cable Route Adapter Kit and either the E3663AC Support Rail Kit or 1494-0413 Rack Slide Kit. The 1494-0413 Rack Slide Kit can be mounted in non-Agilent rack cabinets using 1494-0061 End Brackets.

EMC Filler Panel (1-slot wide)

The Agilent E8400-60202 filler panel (1-slot wide) provides continuous EMC connection across the mainframe front opening. This helps reduce radiated emissions and increases ESD immunity. All Agilent VXI modules include EMC contacts to adjacent slots.

VXI Slot Filler Panel (1-slot wide)

The E8400-44305 VXI Slot Filler Panel is 1-slot wide and is used to cover unused slots, providing a smooth appearance and preventing access. In addition to the cosmetic and safety value, the slot filler panel suppresses acoustic noise and improves airflow. The E8400-44305 does not include EMC contacts.

Air Flow Restrictor (1-slot)

The one-slot E8400-80917 Air Flow Restrictor blocks airflow in one empty slot.

Intermodule Chassis Shield Kit (1-slot wide)

The E8400-80919 Chassis Shield Kit (1-slot wide) provides additional shielding between noisy modules. These shields are relatively easy to install.

Documentation

Mainframe documentation consists of a User/Service Manual which describes electrical and mechanical aspects of the mainframe and accessories. The manual is included on Agilent's Universal Instrument Drivers CD-ROM supplied with the mainframe and is also available on Agilent's Website. A printed copy of the manual is also included.

Warranty

Agilent Technologies provides a standard 3-year return-to-Agilent warranty on this mainframe. E8408A Opt. W01 converts the standard warranty to 1-year On-Site.

Product Specifications**Mechanical**

Mainframe height: (horizontal orientation)	Without bumpers 133 mm (5.25 in.) (3 EIA rack units)
Mainframe width:	362 mm (14.3 in.)
Mainframe depth:	540 mm (21.3 in.)
Mainframe weight:	8.6 kg (19 lbs.)
Mainframe height: (horizontal orientation)	With bumpers 152 mm (6.0 in.) (3 EIA rack units)
Mainframe width:	388 mm (15.3 in.)
Mainframe depth:	548 mm (21.6 in.)
Mainframe weight:	9.1 kg (20 lbs.)

Available Current

Voltage	Peak Current I_{MP}^1 (Amps) From 0 - 55° C: ²	Dynamic Current I_{MD}^1 (Amps) From 0- 55° C: ³
+5V: ^{4, 5}	17 A	2.5 A
+12V: ⁶	2.7 A	1.0 A
-12V: ⁶	2 A	0.8 A
+24V:	2 A	1.0 A
-24V:	2 A	1.0 A
-5.2V: ⁵	2 A	1.0 A
-2V:	2 A	1.0 A

- Specifications apply at the mainframe backplane, 0 - 55° C.
- I_{MP} = Rated mainframe peak dc output current as defined by the VXIbus Specification.
- I_{MD} = Rated mainframe peak-to-peak dynamic current as defined in the VXIbus Specification by a current vs. frequency curve.
- +5V must have a 1.0 A minimum load for other supplies to be in regulation specification.
- Maximum +5V current can be increased if -5.2V load is less than 2.0 A maximum or -2V load is less than 2.0 A maximum. Maximum = 17.0 A + 1.2*(2.0 A - Load on -5.2V) + 0.4*(2.0 A - Load on -2V).
- Maximum +12V current can be increased if -12V load is less than 2.0 A maximum. Maximum = 2.7 A + 1.2*(2.0 A - Load on -12V).

Power

Temperature range:	0 to 40° C	40 to 50° C	50 to 55° C
Usable power (90-264 Vac):	175 W	150 W	125 W

Power Input

Input voltage/frequency:	90 Vac min. - 140 Vac max.: 47 Hz min. - 440 Hz max. 90 Vac min. - 264 Vac max.: 47 Hz min. - 66 Hz max. 280 VA max.
---------------------------------	--

Inrush current:

At input voltage 132 Vac:	<35 A typical
At input voltage 264 Vac:	<75 A typical

Power Switch

On/Standby switch on front panel.

Power Supply Protection

All voltages are protected from over-temperature, over-voltage, short-to-ground and short-to-other-output.

Acoustic Noise

(Sound power at bystander position one meter in front of mainframe)

High-speed fan:	<40 dBA
Variable fan on low speed:	<30 dBA

(Agilent E8408A continued)

Shielding

Front panel EMC gasketing:	Front panel gasketing provided per VXI Rev. 1.4, B.7.2.3
Backplane shielding:	Backplane connector shields per VXI Rev. 1.4, B.7.2.3
Intermodule chassis shielding:	Intermodule chassis shields per VXI Rev. 1.4, B.7.3.4

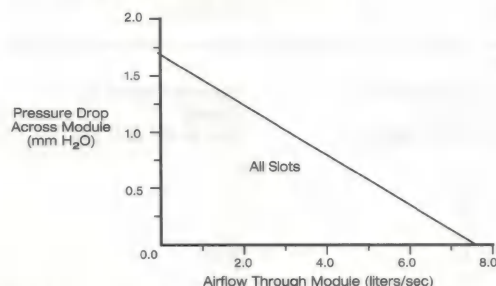
Airflow

Airflow is routed into the mainframe rear and exhausted out the left side (viewed from the front with E8408A in horizontal position). When the mainframe is rack-mounted, allow 50 mm of clearance at the rear and left side for proper air flow.

Fan Speed

(Cooling Mode, High or Variable set by front panel switch)

High fan speed mode:	Maximum airflow all the time
Variable fan speed mode:	Fan speed changes between high and low as a function of ambient and power supply temperature.

Agilent E8408A Cooling Specification Chart

VXI-8 Specification Draft 2.0. Fixture revision 1.7.

- VXI-8 Standard Modules installed in all other slots.
- Measurements taken at 1,500 m altitude.

Backplane Specifications

- Solid-state automatic daisy-chain jumpering for BUS GRANT and IACK signals.
- Full differential distribution of CLK10.
- ACFAIL* and SYSRESET* in full compliance with the VMEbus and VXIbus Specifications.
- Surface mount construction and no sockets for maximum reliability.

Mainframe Monitor Specifications

Indicators: (front panel)	Power supply output voltages monitor Power supply temperature monitor Fan status monitor
Switches: (front panel)	On/Standby Fan Mode: Switches fan between Full Speed and Variable Speed modes

Environmental**Temperature**

Operating temperature range:	0° C to +55° C
Storage temperature range:	-40° C to +70° C

Humidity (non-condensing)

Operating humidity range:	Up to 95% RH from 0° C to +40° C, Up to 65% RH from +40° C to +55° C
Storage humidity range:	Up to 95% RH from 0° C to +55° C, Up to 90% RH from +55° C to +65° C

Altitude: Up to 3,000 m

Standards Compliance

100% compatible with the VXIbus Specification Rev 1.4.

Repair

MTTR = Mean Time to Repair

MTTR, power supply:	<20 min. (w/mainframe and modules fully installed in rack)
MTTR, fan:	<30 min. (w/mainframe and modules fully installed in rack)

General Specifications**VXI Characteristics**

VXI device type:	Mainframe
Data transfer bus:	All per VXIbus Specification, Rev 1.4
Size:	C
Slots:	4 available
Connectors:	P1/P2
Shared memory:	n/a
VXI buses:	All per VXIbus Specification, Rev 1.4

Configuration Guidelines

The following Agilent VXI modules are not supported by the E8408A:

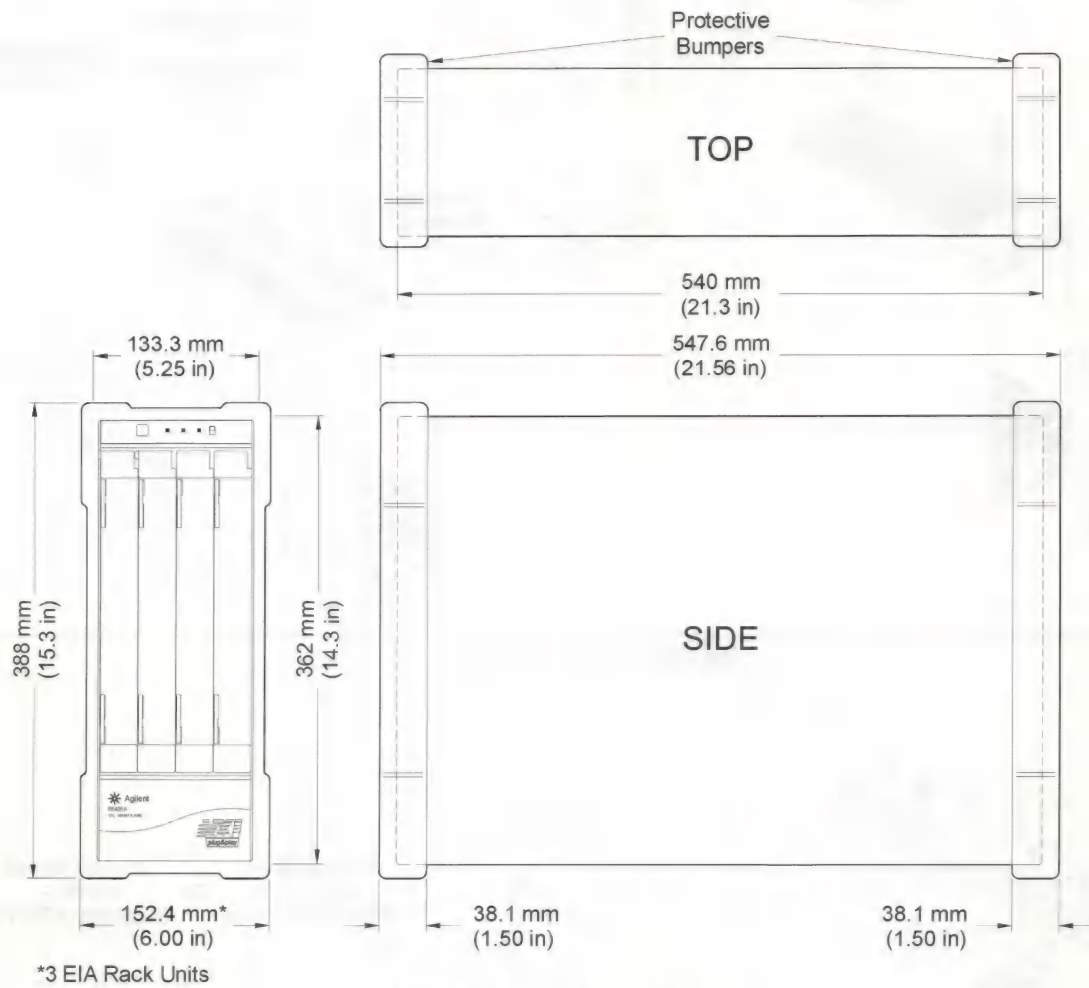
- E9850/51A VXI Embedded PC Controller
- E1430A 10 MSa/s ADC
- E1437A 20 MSa/s ADC
- E1445A Arbitrary Function Generator
- E1450A/1A/2A Timing & I/O Modules
- E1740A Time Interval Analyzer

Ordering Information

Description	Product No.
4-Slot, C-size, 175 W VXI Mainframe, (includes front panel indicators, protective bumpers, & carrying handle)	E8408A
Installed Backplane Connector Shields	E8408A 918
Convert 3-year return-to-Agilent to 1 year On-Site Warranty	E8408A W01
Rack Mount/Cable Route Adapter Kit	E8397A
User/Service Manual (if ordered separately)	E8408-90001
Airflow Restrictor (1-slot)	E8400-60007
Intermodule Chassis Shield Kit	E8400-80919
EMC Filler Panel (1-slot)	E8400-60202
VXI Slot Filler Panel (1-slot)	E8400-44305
Field Installation Kit for Rack Mount/Cable Route Adapter	E8408-80923
Support Rail Kit for VXIplug&play (VPP-8)	
Rack Mount Kit (used w/E8397A)	E3663AC
Rack Slides to mount in Agilent rack cabinet (used w/E8397A)	1494-0413*
Replacement 175 W Power Supply Module	E8408-69005
Replacement Fan Assy	E8408-68500

*Note: For customers with non-Agilent racks, you must also order 1494-0061 End Brackets to adapt 1494-0413 Rack Slides.

(Agilent E8408A continued)

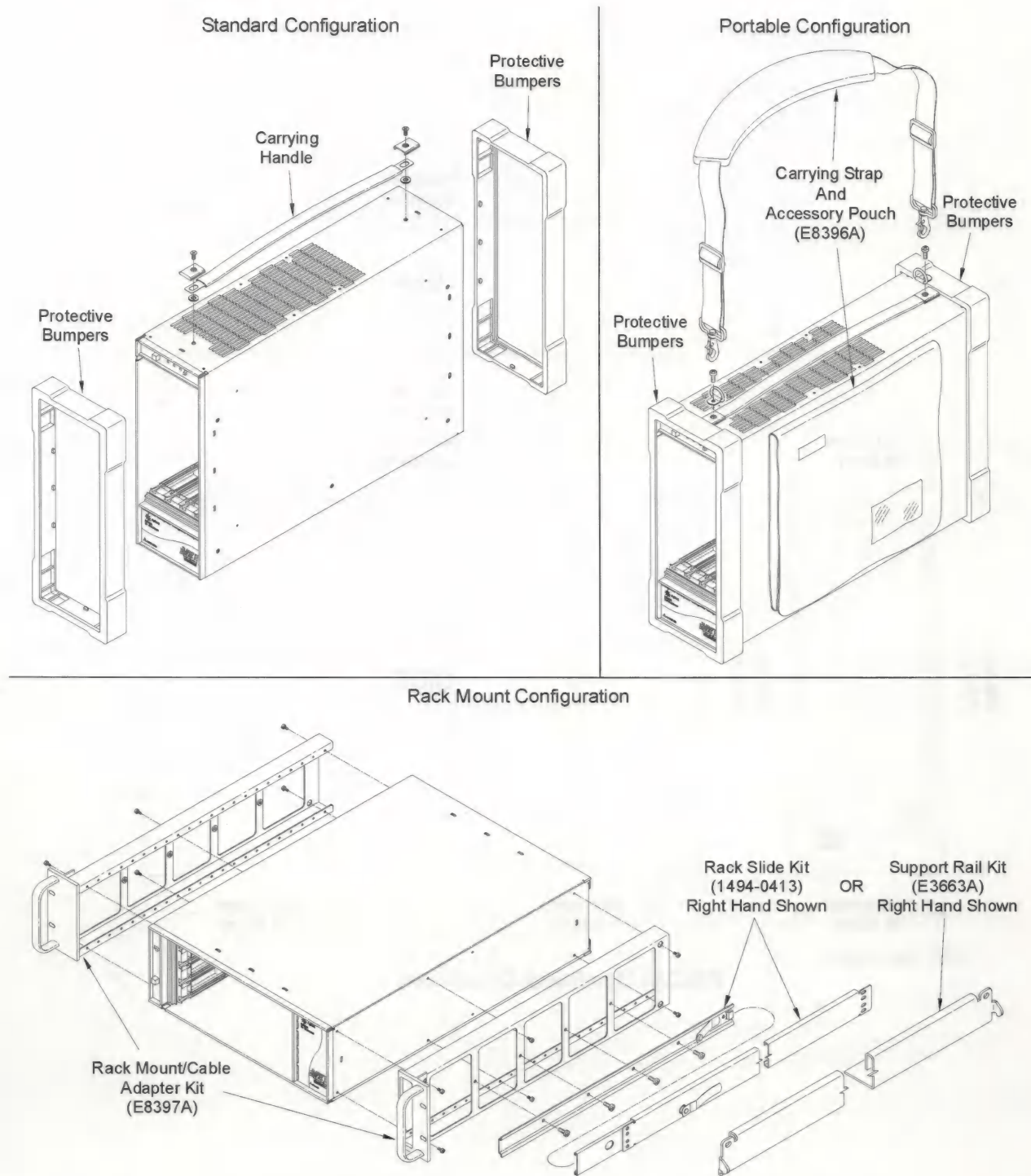


E8408A Mainframe Dimensions

08

(Agilent E8408A continued)

08

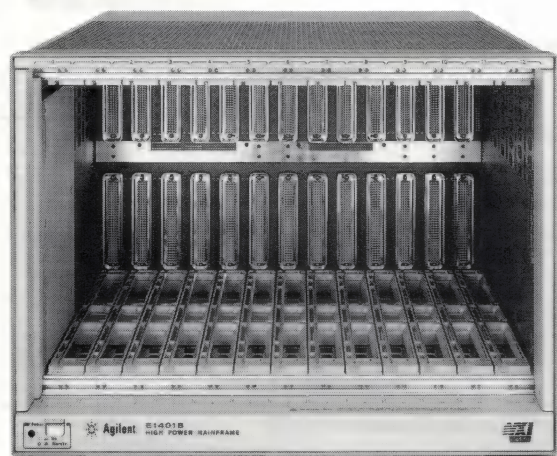


E8408 Mainframe Configurations/Options

Publication No.: 5968-3564E

C-Size, High-Power VXI Mainframe, 13-Slot

Agilent E1401B



Agilent E1401B

- 13-Slot, C-size
- High peak and dynamic currents
- Ultra-reliable power supply
- Easy to service while mounted in a test rack
- MTTR 5 minutes for power supply or fans
- Improved, uniform airflow

Description

The E1401B is Agilent Technologies' high-power, high-performance C-size, 13-slot VXI mainframe. Ample dynamic and peak currents are available for the most demanding, power-hungry applications.

The Agilent E1401B is well suited for applications that require high-density instrumentation. The E1401B complies with the VXIplug&play Specification, and an optional rack mount kit is available for attaching VXIplug&play-defined interconnect fixtures. This mainframe also complies with the VXI Specification by providing injector surface rails used by the QIUC easy module insertion and extraction system. Agilent's industry-leading Pressurized Air Channel cooling technology is integrated into this C-size mainframe.

This mainframe provides for easy airflow and power supply serviceability via the rear panel. The backplane features solid state automatic daisy-chain jumpering for VMEbus grant and interrupt acknowledge lines, eliminating the need for hand selection of switch settings. It is also compatible with the Agilent backplane connector shield kit (p/n E1400-80920).

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

General Characteristics

Airflow and Power Supply Serviceability

- Power input and cooling air intake is through the rear
- Power supply is serviceable through the rear panel
- Cooling air exhaust is through the sides and top
- Three air filters are mounted on the rear panel, accessible without tools for cleaning
- Cableless power supply interconnect to the backplane eliminates risk of miswiring

Product Specifications

VXI Characteristics

VXI device type:	Mainframe
Data transfer bus:	All per VXIbus Specification, Rev. 1.4
Size:	C
Slots:	13
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	All per VXIbus Specification, Rev. 1.4

Remote Monitoring

A connector on the rear panel provides access to all the power supply voltages, remote on/standby, ACFAIL, SYSRESET, and +5VSTDBY.

Mechanical Specifications

	mm	inches
Height without bottom feet:	310	12.2
Height with bottom feet:	323	12.7
Height with cable tray:	352 or 396	13.9 or 15.7
Width:	426	16.8
Depth without rear feet:	574	22.6
Depth with rear feet:	590	23.2
Weight:	21 kg / 46 lbs	

Allow at least 100 mm (4 in) in front of the mainframe for terminal modules and cabling.
Allow 1 rack unit (EIA) = 1.75 inches for top ventilation.

Power

The power supply generates backplane logic signals ACFAIL* and SYSRESET* in full compliance with the VXI Specification, Revision 1.4.

Temp.	Available Power 120-240 Vac ⁽¹⁾	Usable Power 120- 240 Vac Input ⁽²⁾	Usable Power 100 Vac Input ⁽²⁾
25° C	1690 W	900 W	650 W
40° C	1690 W	800 W	650 W
55° C	1488 W	700 W	650 W

- (1) Sum of voltages times the currents—not always usable due to thermal shutdown.
(2) Total output before thermal protection shutdown.

Power Supply Protection

All outputs are protected from over-temperature, over-voltage, over-current, short-to-ground, and short to other supplies. Protection made is full shutdown. Recovery occurs when standby or line is recycled.

Power Input

50-60 Hz input power:

Automatic voltage ranging, nominal range: 100-240 Vac $\pm 10\%$
Nominal frequency range: 50-60 Hz $\pm 10\%$

400 Hz input power:

Nominal voltage range: 100-120 Vac $\pm 10\%$
Nominal frequency: 400 Hz $\pm 10\%$

dc input power:

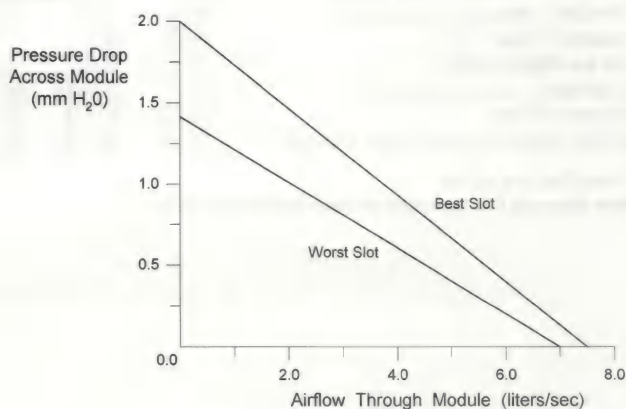
Input voltage range: 100 Vdc min. - 370 Vdc max.
40 A max.

Inrush current:

+5VSTDBY: 1 A max. (user-supplied; power taps located on rear for input of standby voltage and ground to backplane)

Note: Cannot be used on GFI circuit.

Agilent E1401B Cooling Specification Charts



VXI-8 Specification Draft 2.0, Fixture revision 1.7

-
- Pressure Drop Across Module (mm H₂O)
- Worst Slot
- Airflow Through Module (liters/sec)
- | Airflow Through Module (liters/sec) | Pressure Drop Across Module (mm H ₂ O) |
|-------------------------------------|---|
| 0.0 | 6.0 |
| 4.0 | 4.5 |
| 8.0 | 3.0 |
| 12.0 | 1.5 |
| 14.0 | 0.0 |

- Performance shown for Worst Slot (slot 3). Airflow is greater in all other slots.
- Fans on Full Speed.
- Measurements taken at 1,500 m altitude.

Acoustic Noise

Recommended Configurations

Basic Recessed Rack-mount:
Smoked Acrylic Door:
Rack Slides:
Cable Tray: 44.5 mm (1.75 in.) or:
88.9 mm (3.5 in.):

A	B	C	D	E	F	G	H	I	J	K	L
•	•	•	•	•	•	•	•	•	•	•	•
		•	•	•	•	•					
•	•	•					•				
	•		•	•			•	•	•		
•	•	•	•	•			•	•	•		

Option 908 - Flange Kit:
Option 914 - Cable Tray Kit:
Option 915 - Smoked Acrylic Door Kit:
Option 916 - Recess Mount Kit:
E3665AC Rail Kit (preferred for E366XX racks):
Option 917 - VXi Support Rail Kit:
Rail Kit from Non-Agilent Rack Vendor:
1494-0058 - Heavy-duty Rack Slide Kit**:
1494-0064 - Slide Brackets
(for non-Agilent racks):
E1400-80002 - Cable Access Panel
44.5 mm (1.75 in.):
E7731A - Agilent Rack Filler Panel, 1 EIA Unit:

A	B	C	D	E	F	G	H	I	J	K	L	For re-orders use part number:
				•		•			•		•	5063-9218
		•	•	•			•	•	•			E1400-80004
		•	•	•	•	•						E1400-80915
		•		•		•	•		•	•	•	E1401-80916
			•		•	•		•	•	•	•	E3665AC
			•		•	•		•	•	•	•	E1401-80917
			•		•	•		•	•	•	•	Not sold by Agilent
•	•	•					•					1494-0058
•	•	•					•					1494-0064
		•		•				•	•	•		E1400-80002
		•	•	•				•	•	•		E7731A

****Cable Tray Kit is required.**

Note: Select only ONE from within the boxes with the heavy border.

Intermodule:

Intermodule gasketing provided per
VXI Rev. 1.4, B.7.2.3

Backplane:

Backplane connector shields per VXI Rev. 1.4, B.7.2.3 (available as Opt 918 and as a separate accessory, Agilent F1400-80920)

Intermodule chassis:

Intermodule chassis shields per VXI Rev. 1.4, B.7.3.4 (available as a separate product, Agilent E1409B)

Electromagnetic Compliance

To ensure compliance with RFI levels specified in standards EN55011 and CISPR11, the Backplane Connector Shields must be installed in the mainframe. Order Option 918 to get shields installed at the factory. The Agilent E1409B C-Size Chassis Shield allows grounded shielding between mainframe slots in the E1401B and E1421B VXI Mainframes. This shield fits between slots not using up a mainframe slot.

EMC MIL-STD-461 Specifications

Within the requirements of MIL-STD-461 methods CE01, CE03 (relaxed 30 dB below 2 MHz, relaxed 10 dB between 2 and 15 MHz), CS01, CS02, CS06, RE01 (relaxed to 10 dB), RE02, RS02, and RS03.

Recess Rack-Mounting Configuration Guide

Find the column (A, B, C, etc.) that contains the desired combination of rack-mounting components, then follow the column down for ordering information.

Recess rack mounting is preferred for VXL mainframes using modules with QUIC terminal blocks (see the Interconnect and Wiring section). Recess rack mounting allows room for these terminal blocks in a standard rack with a door.

(Agilent E1401B continued)

Bench Top Mounting

Find the column (A, B, or C) that contains the desired rack-mounting components, then follow the column down for ordering information.

Recommended Configurations

Desired rack mounting components:	A	B	C
Benchtop:	•	•	•
Cable tray: 44.5 mm (1.75 in.) or 88.9 mm (3.50 in.):	•	•	•
Handles:	•	•	•

You Need to Order

	A	B	C	For re-orders use part number:
Option 907 - Handle Kit:	•	•	•	E1400-80907
Option 914 - Cable Tray Kit:	•	•	•	E1400-80004

Flush Rack-Mounting

Find the column (A, B, C, etc.) that contains the desired rack-mounting components, then follow the column down for ordering information.

Recommended Configurations

Desired rack-mounting components:	A	B	C	D	E
Basic Flush Rack-mount:	•	•	•	•	•
Cable Tray: 44.5 mm (1.75 in.) or 88.9 mm (3.50 in.):	•	•	•	•	•
Handles:	•	•	•	•	•
Rack slides:	•	•	•	•	•

You Need to Order

	A	B	C	D	E	For re-orders use part number:
Option 908 - Flange Kit:			•		•	5063-9218
Option 909 - Handle and Flange Kit:	•	•		•		5063-9225
Option 914 - Cable Tray Kit:	•	•	•			E1400-80004
E3665AC - Rail Kit (preferred for Agilent E366XX racks):		•	•	•	•	E3665AC
Option 917 - Support Rail Kit (for any Agilent rack):		•	•	•	•	E1401-80917
Rail Kit from Non-Agilent Rack Vendor:		•	•	•	•	Not sold by Agilent
1494-0058 - Heavy-duty Rack Slide Kit**:	•					1494-0058
1494-0064 - Slide Brackets (for non-Agilent racks):	•					1494-0064
E1400-80002 - Cable Access Panel 44.5 mm (1.75 in.):	•	•	•			E1400-80002
E7731A - Agilent Rack Filler Panel, 1 EIA Unit:	•	•	•			E7731A

Note: Select ONE from within the box with the heavy border.

** Cable Tray Kit is required.

Mainframe Options and Rack-mount Configuration Examples

The following is a sample mainframe order including mainframe options from the E1401B Ordering Guide and a rack-mount configuration taken from the Recess Rack-mounting Configuration Guide. Begin by selecting the correct chart for Bench Top Mounting, Flush Rack-mounting, or Recess Rack-mounting as desired. Check off the rack-mount components you will need and find the vertical column that matches your configuration. Follow that column down to find option and part numbers for ordering.

Recess Rack-mount Configuration

Rack-mount components selected in column F: Smoked Acrylic Door, Cable Tray, Handles. Place order for:

Mainframe Options

Description	Product No.
High-Power VXI Mainframe, C-Size, 13-Slot	E1401B
VXI Module Installation w/standard address	E1401B 500
Additional Service Manual	E1401B 0B1
3 yr Retn to Agilent to 1-yr OnSite Warr	E1401B W01
Spare Power Supply 650 W	E1401-69202
Backplane Connector Shield Kit	E1401B 918

Rack-mount Options

Description	Product No.
Handle and Flange Kit	E1401B 909
Cable Tray Mounting Kit	E1401B 914
Smoked Acrylic Door Kit that mounts in front	E1401B 915
Recess Mounting Kit	E1401B 916

Select one of the following based on the rack system you use:

Description	Product No.
Rail Kit (use w/Agilent E366XX racks)	E3665AC
Support Rail Kit ⁽¹⁾	E1401B 917
Rail kit from non-Agilent vendor	n/a

Select any of the following based on need for cable access:

Description	Product No.
Cable Access Panel (44.5 mm/1.75 in.)	E1400-80002
Filler Panel (one EIA unit)	E7731A

⁽¹⁾ For any Agilent rack.

Flush Rack-mount Configuration

Components selected in column A: cable Tray (either 44.5 mm or 88.9 mm), Handles, Rack Slides. Place order for:

Mainframe Options

Description	Product No.
High-Power VXI Mainframe, C-Size, 13-Slot	E1401B
VXI Module Installation w/standard address	E1401B 500
Additional Service Manual	E1401B 0B1
3 yr Retn to Agilent to 1-yr OnSite Warr	E1401B W01
5 yrs of Customer Return Repair Service	E1401B W50
Spare Power Supply 650 W	E1401-69202
Backplane Connector Shield Kit	E1401B 918

Rack-mount Options

Description	Product No.
Handle and Flange Kit	E1401B 909
Cable Tray Mounting Kit	E1401B 914

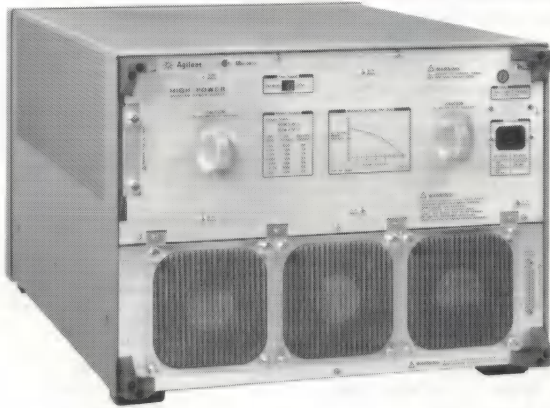
Select one of the following based on the rack system you use:

Description	Product No.
Heavy Duty Rack Slide Kit, non-tilt	1494-0058
Slide Brackets for non-Agilent racks	1494-0064

(Agilent E1401B continued)

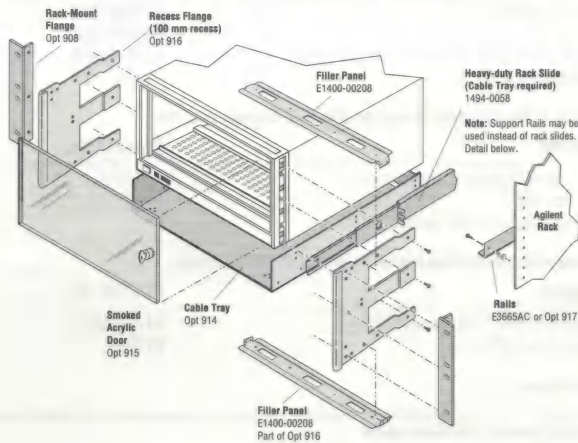
Select any of the following based on need for cable access:

Description	Product No.
Cable Access Panel (44.5 mm/1.75 in.)	E1400-80002
Filler Panel (one EIA unit)	E7731A



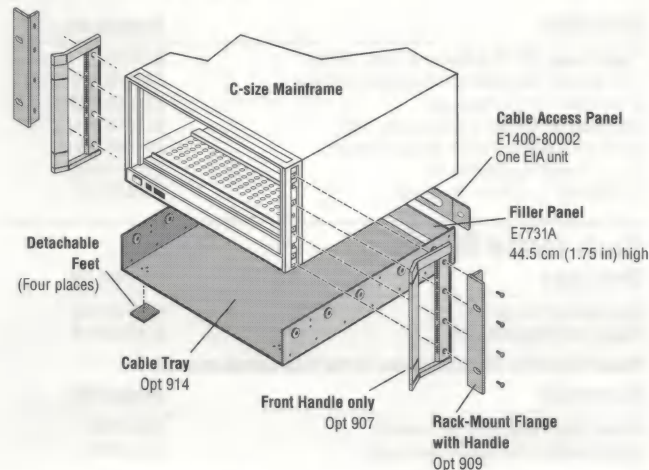
Recess and Flush Rack-Mounting Details

Note: Nonrecess rack-mounting is possible simply by mounting Rack Flanges directly to the mainframe. The Smoked Acrylic Door, however, may not be used except in the recess mounted mode with the Recess Mount Kit (Opt 916). The cable tray is optional.



Cable Tray Details

Note: Cable tray may be mounted in one of two positions, allowing either a 44.5 mm or 88.9 mm cable opening.



Available Current

	At 55° C	At 40° C	
	I _{MP} , Amps	I _{MP} , Amps	I _{MD} , Amps
+5 V:	60.00	65.00	9.00
+12 V:	12.00	14.00	2.50
-12 V:	12.00	14.00	2.50
+24 V:	12.00	14.00	5.00
-24 V:	10.00	12.00	5.00
-5.2 V:	60.00	65.00	8.50
-2 V:	30.0	35.00	4.50

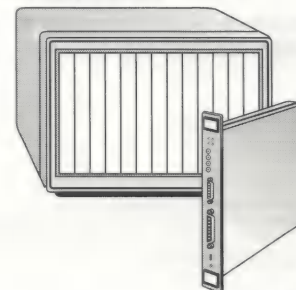
Cooling/Slot

Watts/slot:	60 W (10° C rise)
ΔP mm H ₂ O:	n/a
Air Flow liter/s:	n/a

Ordering Information

Description	Product No.
High-Power VXI Mainframe, C-Size, 13-Slot	E1401B
Additional Service Manual	E1401B 0B1
Front Handle Kit	E1401B 907
Flange Kit	E1401B 908
Handle and Flange Kit	E1401B 909
Cable Tray Mounting Kit	E1401B 914
Smoked Acrylic Door Kit that mounts in front	E1401B 915
Recess Mounting Kit	E1401B 916
Support Rail Kit ⁽¹⁾	E1401B 917
Backplane Connector Shield Kit	E1401B 918
Japanese Localization	E1401B ABJ
3 yr Retn to Agilent to 1-yr OnSite Warr	E1401B W01
5 Yrs of Customer Return Repair Service	E1401B W50
Japanese Localization (if ordered separately)	E1401-90007
Spare Power Supply 650 W	E1401-69202
Handle and Flange Kit	E1400-80909
Filler Panel 1 Slot	E1400-60202
Panel, 3 Slot Filler	E1400-00203
Panel, 7 Slot Filler	E1400-00204
Front Handle Kit	E1400-80907
Rack Mount Kit 310.4H	5063-9218
Rack Adapter Kit 310.4H	5063-9225
Cable Access Panel (44.5 mm/1.75 in.)	E1400-80002
Cable Tray Kit for E1401B	E1400-80004
VXI Door/Window Assembly w/Lock	E1400-80915
Plug&play Rack Mount Kit	E1401-61200
Recess Rack Mount Kit for E1401B	E1401-80916
Rack Mount Rail Kit for Recess Mount	E1401-80917
Backplane Connector Shield Kit	E1400-80920
Rail Kit (use w/E366XX racks)	E3665AC
Heavy Duty Rack Slide Kit, non-tilt	1494-0058
Slide Brackets for non-Agilent racks	1494-0064
Filler Panel (one EIA unit)	E7731A
Series C Chassis Shield for E1401B	E1409B

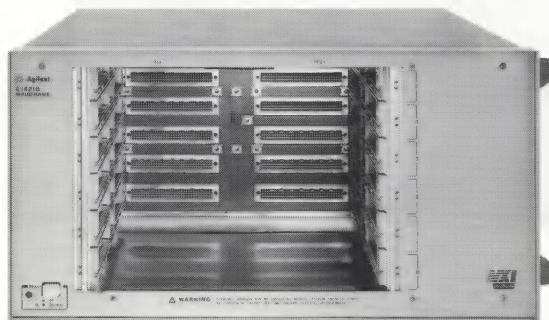
⁽¹⁾ For any Agilent rack.

Agilent E1401B
C-size MainframeAgilent E1406B
C-size GPIB
Command Module

Publication No.: 5965-5527E

6-Slot, C-Size VXI Mainframe

Agilent E1421B



Agilent E1421B

- 6-Slot, C-size
- Compact size, low cost
- Portable or rack-mount
- Ultra-reliable power supply
- Power supply serviceable through the rear panel
- Pressurized air channel cooling

Description

The Agilent Technologies E1421B C-size, 6-slot VXI mainframe is a compact, cost-effective solution for configurations requiring fewer slots than the 13-slot E1401B or E84XX series C-size mainframes.

The smaller size and weight of the E1421B make it an excellent choice for either portable or rack-mount applications. The E1421B complies with the VXIbus Specification by providing injector surface rails used by the QIUC easy module insertion and extraction system.

Agilent has incorporated its industry-leading Pressurized Air Channel cooling system into the design of the E1421B. It ensures clean, uniform airflow to each module. For greater power supply serviceability, power input intake is through the rear of the mainframe. Airflow is through the right side and exhausts through the left.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

General Characteristics

Airflow and Power Supply Serviceability

- Power input through the rear
- Power supply serviceable through the rear panel
- Cooling air enters through right side and exhausts through the left side
- No air filters

Backplane

- High performance
- Monolithic
- 6 slots
- VXI P1 and P2 connectors

The backplane features solid state automatic daisy-chain jumpering for the VMEbus grant and interrupt acknowledge lines, eliminating the need for hand selection of switch settings. The E1421B backplane is compatible with the Agilent backplane connector shield kit, P/N E1400-80920.

Product Specifications

Mechanical Specifications

	mm	inches
Height without bottom feet:	221.5	8.72
Height with bottom feet:	233.4	9.19
Width without side feet:	425.5	16.75
Width with side feet:	447.8	17.63
Depth with rear feet + power supply handles:	558.8	22.00
Weight:	13.9 kg / 30.6 lbs	

Power

The power supply generates backplane logic signals ACFAIL* and SYSRESET* in full compliance with the VXI Specification, Revision 1.4.

Usable power: 450 W maximum at 55° C

Power Supply Protection

All outputs are protected from over-temperature, over-voltage, over-current, and short-to-ground.

Power Input

50-60 Hz input power:

Automatic voltage ranging, nominal range: 100-240 Vac $\pm 10\%$
Nominal frequency range: 50-60 Hz $\pm 10\%$

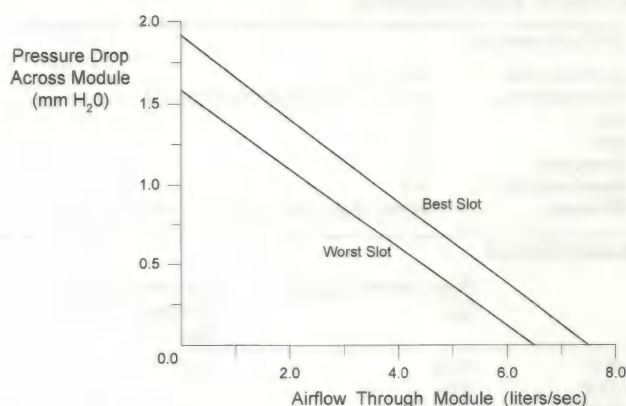
400 Hz input power:

Nominal voltage range: 100-120 Vac $\pm 10\%$
Nominal frequency: 400 Hz $\pm 10\%$

Inrush current:

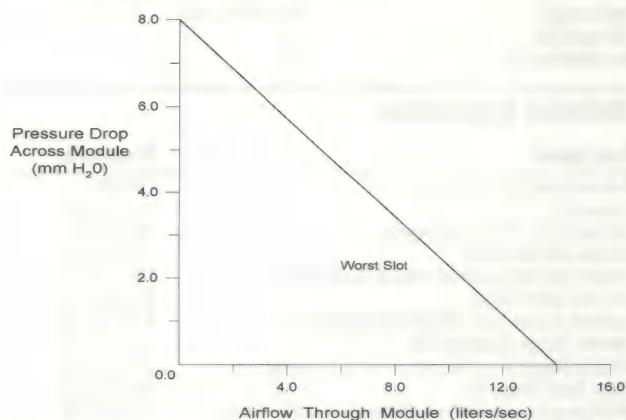
40 A max

Agilent E1421B Cooling Specification Charts



VXI-8 Specification Draft 2.0. Fixture revision 1.7.

- VXI-8 Standard Modules installed in all other slots.
- Performance shown for Worst Slot (slot 1) and Best Slot (slot 4).
- Front-to-Rear Variance 19% worst case.
- Fans on Full Speed.
- Measurements taken at 1,500 m altitude.



All other slots blocked. Airflow decreases as additional slots are opened.

- Performance shown for Worst Slot (slot 1). Airflow is greater in all other slots.
- Fans on Full Speed.
- Measurements taken at 1,500 m altitude.

Environmental and Regulatory

Acoustic noise:

Low-speed fan: 53 dBA sound pressure (at bystander position)
High-speed fan: 59 dBA sound pressure (at bystander position)

(Agilent E1421B continued)

Shielding

Intermodule:	Gasketing per VXI Rev. 1.4, B.7.2.3. is provided.
Backplane:	Backplane Connector Shields per VXI Rev. 1.4, B.7.2.3 (available as Option 918 or as a separate accessory, p/n E1400-80920)
Intermodule chassis:	Intermodule chassis shields per VXI Rev 1.4, B.7.3.4 (available as a separate product, p/n E1409B)

Electromagnetic Compliance

To ensure compliance with RFI levels specified in standards EN55011 and CISPR11, the Backplane Connector shields must be installed in the mainframe. Order Option 918 to get shields factory installed.

The Agilent E1409B C-Size Chassis Shield allows grounded shielding between mainframe slots in the E1401B and E1421B VXI Mainframes. This shield fits between slots – not using up a mainframe slot.

General Specifications**VXI Characteristics**

VXI device type:	Mainframe
Data transfer bus:	All per VXIbus specification, Rev. 1.4
Size:	C
Slots:	6
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	All per VXIbus Standard Specification, Rev. 1.4

Available Current

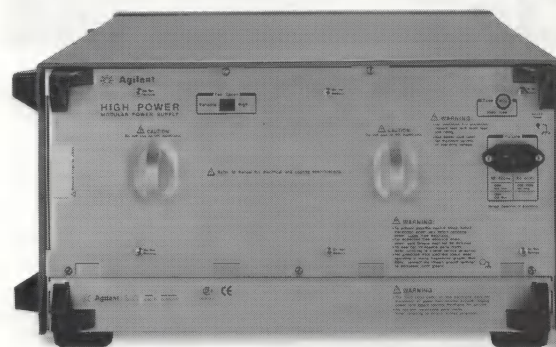
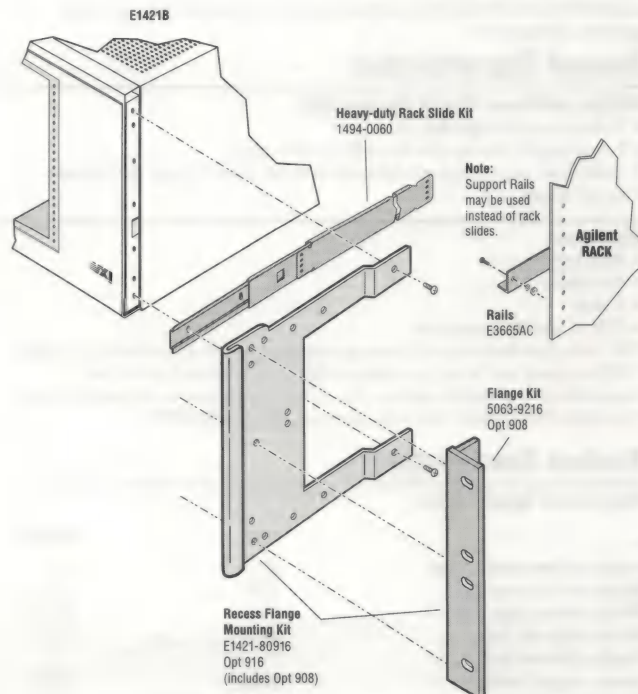
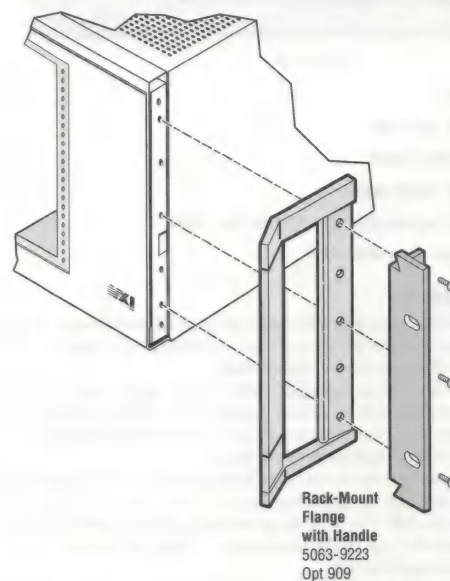
	Peak Current (Amps) I_{MP}	Dynamic Current (Amps) I_{MD}
+5 V:	45.00	5.00
+12 V:	8.00	2.50
-12 V:	8.00	2.50
+24 V:	8.00	4.00
-24 V:	8.00	4.00
-5.2 V	40.00	5.00
-2 V:	15.00	3.50

Cooling/Slot

Watts/slot:	60 W (10° C rise)
ΔP mm H₂O:	n/a
Air Flow liter/s:	n/a

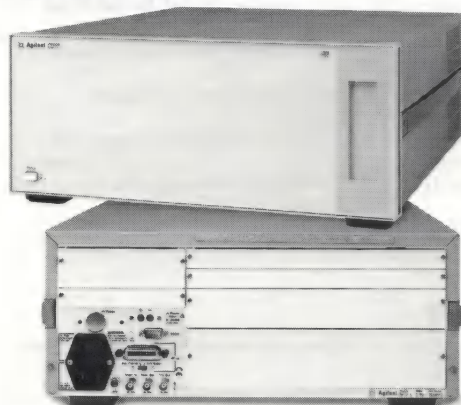
Ordering Information

Description	Product No.
6-Slot, C-Size VXI Mainframe	E1421B
Flange Kit	E1421B 908
Flange Kit (if ordered separately)	5063-9216
Handle and Flange Kit	E1421B 909
Handle and Flange Kit (if ordered separately)	5063-9223
Smoked Acrylic Door	E1421B 915
Smoked Acrylic Door (if ordered separately)	E1421-61205
Recess Flange Mounting Kit	E1421B 916
Recess Flange Mounting Kit (if ordered separately)	E1421-80916
Flush Rack Flange Kit	E1421-65000
Backplane Connector Shield Kit for 6-Slot Mainframe	E1421B 918
VXI Backplane Connector Shield Kit for 6-Slot Mainframe (if ordered separately)	E1421-80920
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1421B W01
Filler Panel 1 Slot	E1400-60202
Series C Chassis Shield for E1401B	E1409B
Rack Slide Kit	1494-0060
Rack Slide Kit for Non-Agilent Rack	1494-0061
VXI Rail Kit	E3665AC

**E1421B**

B-Size VXI Mainframe, 9-Slot

Agilent E1300B



Agilent E1300B

- 9-Slot, B-size
- Dual fan cooling supports high-power modules
- Low-cost, compact mainframe
- Built-in command module
- GPIB interface and Resource Manager
- SCPI for easy programming

Description

The Agilent Technologies E1300B B-size VXI Mainframe features improved dual fan cooling for support of the most demanding M-Modules and B-size modules. Two of its nine slots are located internally and are dedicated to housing the 2-slot E1326B Multimeter. Three A-size slots are also available for installing other modules. The E1300B mainframe features a built-in high-performance command module with built-in GPIB interface.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Optional Features

The E1300B Mainframe offers 1 or 2 MB non-volatile memory for program and data storage.

Air Flow and Power Supply Serviceability

- Power Input and cooling air intake through the right side
- Cooling air exhaust through the left side

Product Specifications

Mechanical Specifications

	mm	inches
Height without bottom feet:	177	6.97
Height with bottom feet:	189	7.44
Width:	426	16.75
Depth:	510	20.1
Depth with terminal blocks:	569	22.38
Weight:	7.4 kg/16 lbs	

Power Specifications

Power output:

The power supply generates backplane logic signals ACFAIL* and SYSRESET* in full compliance with the VXI Specification, Revision 1.4.

dc Output Voltage

	PK Current I_{MP}
+5 V:	12.2 A
+12 V:	4.6 A
-12 V:	0.9 A

Usable power: 120 W maximum at 40° C

Power Supply Protection

All outputs are protected from over-temperature, over-voltage, over-current, and short-to-ground.

Power Input

Input voltage:	115 Vac to 230 Vac (250 V max)
Input frequency:	50 Hz to 400 Hz

Cooling

Temperature rise:	10° C (through the module for a 25 W module with typical density)
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Environmental and Regulatory

Acoustic noise:	Less than 40 dBA sound pressure at bystander position (measured 1 m. in front of product per DIN 45635T.1)
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General Specifications

VXI Characteristics

VXI device type:	Mainframe
Data transfer bus:	16 bits
Size:	B
Slots:	9 (7 external, 2 internal, 3 external A-size)
Connectors:	P1
Shared memory:	n/a
VXI buses:	none

Cooling/Slot

Watts/slot:	25 W (10° C rise)
ΔP mm H ₂ O:	n/a
Air flow liter/s:	n/a

Available Current

	I_{MP} (A)	I_{MD} (A)
+5 V:	12.20	0
+12 V:	4.60	0
-12 V:	0.90	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Rack-Mounting Details

Configuration Checklist

Find the column (A, B, or C) that contains the desired rack-mounting components, then follow the column down for ordering information.

Recommended Configurations

	A	B	C
Rack-mount:	•	•	•
Handles:	•	•	•
Rails and flanges:	•	•	•

You Need to Order

	A	B	C	For reorders use part number
Option 907 handle kit:	•			5062-3900
Option 908 rack-mount rails/flanges:		•		E1300-80908
Option 909 rack-mount rail/flanges/handles:			•	E1300-80909

(Agilent E1300B continued)

Ordering Information

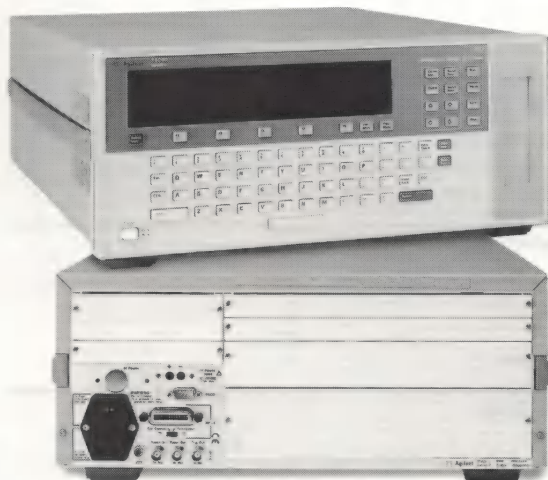
Description	Product No.
9-Slot, B-Size VXI Mainframe	E1300B
E1326B Multimeter Installed Internally	E1300B 009
512 kbyte Nonvolatile Memory Installed	E1300B 010
1 Mbyte Nonvolatile Memory Installed*	E1300B 011
2 Mbyte Nonvolatile Memory Installed	E1300B 012
Front Handle Kit for E1300B Mainframe	E1300B 907
Rackmount Flanges and Rails for E1300B	E1300B 908
Rackmount Flanges, Handles and Rails	E1300B 909
Germany-German Localization	E1300B ABD
France-French Localization	E1300B ABF
Japan-Japanese Localization	E1300B ABJ
Italy-Italian Localization	E1300B ABZ
ANSI Z540 Compliant Calibration	E1300B A6J
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1300B W01
Cover Parts Kit	E1300-06102
Field Install Kit 512 K Memory	E1300-80002
Field Install Kit 1 Mbyte Memory	E1300-80003
Internal Installation Kit for E1326B DVM	E1326-80004
Kit-Binding Post	E1326-80005
Firmware Update to A.07 w/o IBASIC	E1300-80070
Rack Mount Kit w/Rails	E1300-80908
Rack Mount & Handle Kit	E1300-80909
Service Manual	E1300-90015

*Option 011 is required if you are using the E1313A. However, Option 012 is recommended.

Publication No.: 5966-2982E

B-Size VXI Mainframe with Front Panel, 9-Slot

Agilent E1301B



Agilent E1301B

- Dual fan cooling supports high-power modules
- Front panel for manual control
- Low-cost, compact mainframe
- Built-in command module
- GPIB interface and Resource Manager
- SCPI for easy programming

Description

The Agilent Technologies E1301B **B-size VXI mainframe** features improved dual fan cooling for support of the most demanding M-Modules and B-size modules. Two of its nine slots are located internally and are dedicated to housing the 2-slot E1326B Multimeter. Three A-size slots are also available for installing other modules.

The E1301B Mainframe features a built-in high-performance command module with built-in GPIB interface.

The E1301B Mainframe is identical to the E1300B in function, but features a front panel and keyboard for manual control and troubleshooting without the use of GPIB. This makes it an ideal mainframe for remote applications.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Optional Features

The E1301B Mainframe offers 1 or 2 MB non-volatile memory for program and data storage.

Air Flow and Power Supply Serviceability

- Power Input and cooling air intake through the right side
- Cooling air exhaust through the left side

Product Specifications

Mechanical Specifications

	mm	inches
Height without bottom feet:	177	6.97
Height with bottom feet:	189	7.44
Width:	426	16.75
Depth:	510	20.1
Depth with terminal blocks:	569	22.38
Weight:	7.8 kg/17 lbs	

Power Specifications

Power output:

The power supply generates backplane logic signals ACFAIL* and SYSRESET* in full compliance with the VXI Specification, Revision 1.4.

dc Output Voltage	PK Current I _{MP}
+5 V:	12.2 A
+12 V:	4.6 A
-12 V:	0.9 A

Usable power: 120 W maximum at 40° C

Power Supply Protection

All outputs are protected from over-temperature, over-voltage, over-current, and short-to-ground.

Power Input

Input voltage:	115 Vac to 230 Vac (250 V max)
Input frequency:	50 Hz to 400 Hz

Cooling

Temperature rise:	10° C (through the module for a 25 W module with typical density)
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Environmental and Regulatory

Acoustic noise:	Less than 40 dBA sound pressure at bystander position (measured 1 m. in front of product per DIN 45635T.1)
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(Agilent E1301B continued)

General Specifications

VXI Characteristics

VXI device type:	Mainframe
Data transfer bus:	16 bits
Size:	B
Slots:	9 (7 external, 2 internal, 3 external A-size)
Connectors:	P1
Shared memory:	n/a
VXI buses:	none

Cooling/Slot

Watts/slot:	25 W (10° C rise)
ΔP mm H ₂ O:	n/a
Air flow liter/s:	n/a

Available Current

	I_{MP} (A)	I_{MD} (A)
+5 V:	50.00	3.50
+12 V:	8.00	1.50
-12 V:	4.00	0.50
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Rack-Mounting Details

Configuration Checklist

Find the column (A, B, or C) that contains the desired rack-mounting components, then follow the column down for ordering information.

Recommended Configurations

	A	B	C
Rack-mount:		•	•
Handles:	•		•
Rails and flanges:		•	•

You Need to Order

	A	B	C	For reorders use part number
Option 907 handle kit:	•			5062-3900
Option 908 rack-mount rails/flanges:		•		E1300-80908
Option 909 rack-mount rail/flanges/handles:			•	E1300-80909

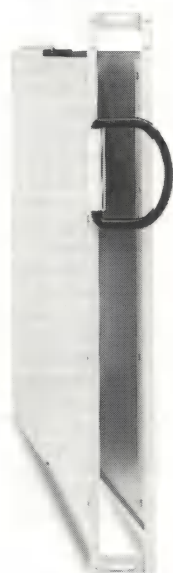
Ordering Information

Description	Product No.
9-Slot, B-Size VXI Mainframe w/Front Panel	E1301B
E1326B Multimeter Installed Internally	E1301B 009
512 KB Nonvolatile Memory Installed	E1301B 010
1 MB Nonvolatile Memory Installed*	E1301B 011
2 MB Nonvolatile Memory Installed	E1301B 012
Front Handle Kit for E1301B Mainframe	E1301B 907
Rack-Mount Flanges and Rails for E1301B	E1301B 908
Rack-Mount Flanges, Handles and Rails	E1301B 909
Germany-German Localization	E1301B ABD
France-French Localization	E1301B ABF
Japan-Japanese Localization	E1301B ABJ
Italy-Italian Localization	E1301B ABZ
ANSI Z540 Compliant Calibration	E1301B A6J
3 yr. Retr. to Agilent to 1 yr. OnSite Warr.	E1301B W01
Cover Parts Kit	E1300-06102
Field Install Kit 512 K Memory	E1300-80002
Field Install Kit 1 Mbyte Memory	E1300-80003
Internal Installation Kit for E1326B DVM	E1326-80004
Kit-Binding Post	E1326-80005
Firmware Update to A.07 w/o IBASIC	E1300-80070
Rack Mount Kit w/Rails	E1300-80908
Rack Mount & Handle Kit	E1300-80909
Service Manual	E1300-90015

*Option 011 is required if you are using the E1313A. However, Option 012 is recommended.

Publication No.: 5966-2980E

A/B to C-Size P1 Active Adapter, 1-Slot Agilent E1403C



Agilent E1403C

- Adapts A- or B-size VXI to C-size VXI
- Fits 1-slot or 2-slot (optional) modules
- Provides active extension of P1 only
- Provides slave-only capability

Description

The Agilent Technologies E1403C 1- or 2-slot VXI carrier adapts **A- or B-size VXI modules** for use in all **C-size VXI mainframes**. P1, which is the only connector available, is a fully buffered extension. The E1403C provides slave-only capability and cannot be used in Slot 0 or with bus masters. The standard module is 1-slot wide; Option 010 is 2 slots wide, however, it only connects to the backplane on the left-most slot. Any number of adapters can be used in an Agilent VXI mainframe.

Many (but not all) VME cards can be adapted for use in C-size VXI mainframes using this module *if* they meet VXI mechanical and electrical restrictions. However, this is not a supported configuration.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Cables

Cables are required for adapting B-size multiplexers in a C-size mainframe. The B-size multiplexers require analog bus cables longer than those shipped, and, therefore, longer ones must be ordered separately to connect Multiplexer-to-Multiplexer and Multiplexer to the Agilent E1411A/B C-size digital multimeter. These cables are necessary when mounting a B-size multiplexer in a C-size adapter because of the different spacing and positioning of the analog bus connectors on the B- and C-size modules. The following cables are available:

1) Agilent E1411A/B DMM to B-size Multiplexer/E1403C Cable part numbers:

Agilent E1326-61611 Analog Bus Cable. The E1326-61611 is the same cable used with the B-size cardcage internal DMM configuration.

Agilent E1411-61601 Multiplexer-to-DMM (FET Multiplexer only). Order the Agilent E1411-80001 cable kit to get both the E1326-61611 long analog bus cable and the E1411-61601 digital bus cable together.

2) B-size Multiplexer/E1403C to B-size Multiplexer/E1403C Cable part numbers:

Agilent E1400-61605 Multiplexer-to-Multiplexer Cable. The E1400-61605 is the same cable used to connect C-size Multiplexers together.

3) C-size Multiplexer to B-size Multiplexer/E1403C Cable part numbers:

Agilent E1326-61611 Analog Bus Cable. The E1326-61611 is the same cable used with the B-size cardcage internal DMM configuration.

General Specifications

VXI Characteristics

VXI device type:	n/a
Size:	C
Slots:	1 or 2
Connectors:	P1
Shared memory:	n/a
VXI buses:	n/a

Module Current

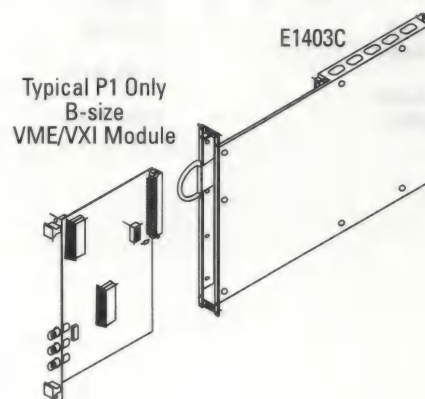
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	0.50
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

Ordering Information

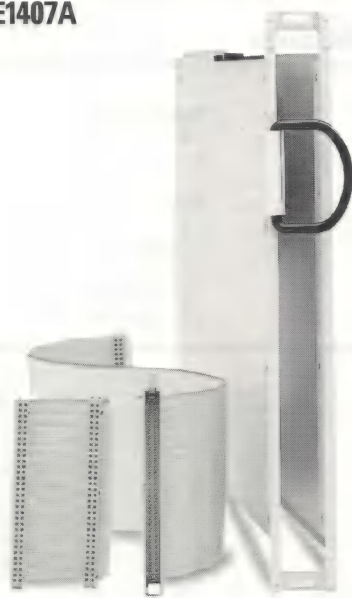
Description	Product No.
A/B to C-size P1 Active Adapter, 1 Slot	E1403C
2-slot Wide Adapter	E1403C 010
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1403C W01



Publication No.: Not available

A/B to C-Size P1/P2 Active Adapter

Agilent E1407A



Agilent E1407A

- Adapts A- or B-size VXI to C-size VXI
- Provides active extensions of P1 and P2
- Fits 1-slot or 2-slot (optional) modules
- Provides slave-only capability
- Allows isolation of outer rows of P2

Description

The Agilent Technologies E1407A C-size, 1- or 2-slot carrier adapts A- or B-size VXI modules for use in all C-size VXI mainframes. The P1 and P2 extensions are fully buffered. A ribbon cable allows isolation of the outer rows of P2 for VME applications. The E1407A provides slave-only capability and cannot be used in Slot 0 or with bus masters. The standard module is 1-slot wide; Option 010 is 2 slots wide, however, it only connects to the backplane on the left-most slot. Any number of adapters can be used in an Agilent VXI mainframe.

Many (but not all) VME cards can be adapted for use in VXI mainframes using this module *if* they meet VXI mechanical and electrical restrictions. However, this is not a supported configuration.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Cables

Cables are required for adapting B-size multiplexers in a C-size mainframe. The B-size multiplexers require analog bus cables longer than those shipped, and, therefore, longer ones must be ordered separately to connect Multiplexer-to-Multiplexer and Multiplexer to the Agilent E1411A/B C-size digital multiplexer. These cables are necessary when mounting a B-size multimeter in a C-size adapter because of the different spacing and positioning of the analog bus connectors on the B- and C-size modules. The following cables are available:

1) Agilent E1411A/B DMM to B-size Multiplexer/E1407A Cable part numbers:

Agilent E1326-61611 Analog Bus Cable. The E1326-61611 is the same cable used with the B-size cardcage internal DMM configuration.

- Agilent E1411-61601 Multiplexer-to-DMM (FET Multiplexer only). Order the Agilent E1411-80001 cable kit to get both the E1326-61611 long analog bus cable and the E1411-61601 digital bus cable together.

2) B-size Multiplexer/E1407A to B-size Multiplexer/E1407A Cable part numbers:

- Agilent E1400-61605 Multiplexer-to-Multiplexer Cable. The E1400-61605 is the same cable used to connect C-size Multiplexers together.
- Agilent E1411-61601 Multiplexer-to-DMM (FET Multiplexer only). Order the Agilent E1411-80001 cable kit to get both the E1326-61611 long analog bus cable and the E1411-61601 digital bus cable together.

3) C-size Multiplexer to B-size Multiplexer/E1407A Cable part numbers:

Agilent E1326-61611 Analog Bus Cable. The E1326-61611 is the same cable used with the B-size cardcage internal DMM configuration.

- Agilent E1411-61601 Multiplexer-to-DMM (FET Multiplexer only). Order the Agilent E1411-80001 cable kit to get both the E1326-61611 long analog bus cable and the E1411-61601 digital bus cable together.

General Specifications

VXI Characteristics

VXI device type:	n/a
Size:	C
Slots:	1/2
Connectors:	P1 or 2
Shared memory:	n/a
VXI buses:	n/a

Module Current

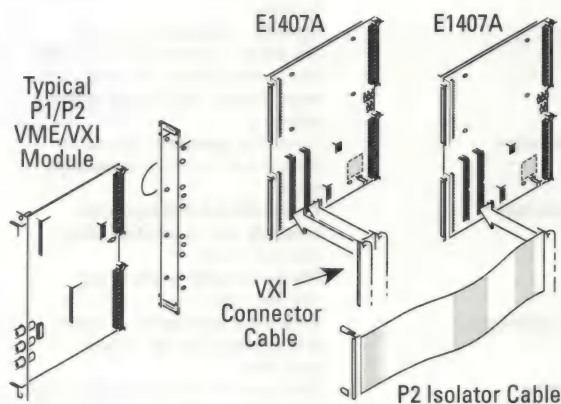
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.07	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0.01	0

Cooling/Slot

Watts/slot:	0.50
ΔP mm H ₂ O:	0.20
Air Flow liter/s:	0.10

Ordering Information

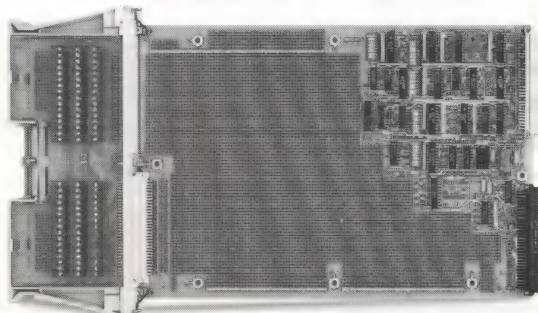
Description	Product No.
A/B-to-C-Size Adapter	E1407A
2-Slot Wide Adapter	E1407A 010
3-yr Retn. to Agilent to 1-yr OnSite Warr.	E1407A W01
5-yr Retn. Repair Service	E1407A W50



Publication No.: Not available

Register-Based Breadboard, C-Size

Agilent E1490C



Agilent E1490C

09

- 1-Slot, C-size, register based
- Reduces design time with the register-based interface
- Includes QUIC easy-to-use terminal block
- Provides a 16-bit register-based interface
- Contains shields and provides the P1/2 connector
- Contains module status/module control registers

Description

The Agilent Technologies E1490C Breadboard is a C-size, 1-slot, register-based VXI module. It contains built-in register-based interfaces, including Programmable Array Logic ICs among other ICs. The majority of PC board space is available for your custom circuitry.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

General Characteristics

Logical address decoding:	The module implements 15 address lines (A1-A15) and provides logical decoding.
Data lines:	Contains 16 buffered data lines.
Registers:	The Series C module contains module status, Manufacturer ID number and model number, and module control registers.
DTACK generation:	Circuitry is provided to generate a delayed data transfer acknowledge signal.
Interrupt interface:	The module has D16 interrupter capability with jumper selectable interrupt priority.
Reset:	Allows complete hardware and software reset.
Backplane buffering:	Buffering is provided for all signals that interface with the VXIbus backplane.
Power supplies:	The C-size interface uses the +5, -5.2, and -2 Vdc supplies and provides all VXI backplane supplies.

Mechanical Specifications

Component area available:	425 cm ² (76 in ²)
Mounting Holes	
Center spacing:	2.54 mm x 2.54 mm (0.1 in x 0.1 in)
Inside diameter:	1.09 mm (0.043 in)
Max. component height:	18 mm (0.71 in) above PC board
Max. lead length:	3.2 mm (0.125 in) below PC board
Terminal block:	Screw terminals standard Optional crimp and insert connectors

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	n/a
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	Local Bus A Local Bus C TTL Trigger Bus ECL Trigger Bus

Module Current*

	I_{PM} (A)	I_{DM}
+5 V:	.350	0
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

*Will depend on user's circuitry.

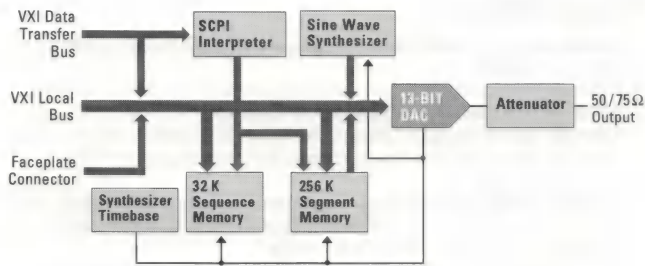
Cooling/Slot

Watts/slot:	2.00
ΔP mm H₂O:	0.05 (typical density)
Air Flow liter/s:	0.08 per watt

Ordering Information

Description	Product No.
Registered-Based Breadboard	E1490C
Crimp and Insert Connectors	E1490C A3E
3 yr retn. to Agilent to 1 yr. OnSite warr.	E1490C W01

Publication No.: Not available

**B-Size Modules**

Product No.	Description
E1328A	4-Channel D/A Converter
VX462B	Pulse Generator (Referenced Product)

C-Size Modules

Product No.	Description
E1418A	8/16-Channel D/A Converter
E1434A	4-Channel 65 kSa/sec Arbitrary Source
E1441A	Arbitrary Waveform Generator
E1445A	Arbitrary Function Generator
E2748A	Vector Waveform Generator
E8311A/E8312A	165 MHz and 330 MHz 2-Channel Pulse/Pattern Generators

Introduction

Agilent Technologies offers a broad line of waveform generators and D/A converters. You can count on more confidence in your test signals, from simulating heartbeats and vibrations to functional verification of high-speed digital devices, and for stimulating devices in your VXI test system. Agilent provides products ranging from low-cost D/A converters to high-performance and highly sophisticated arbitrary function, pulse, and vector waveform generators.

With this selection of analog and digital sources, you can have unlimited flexibility and the ability to link waveform segments at full speed, and to create precise arbitrary, pulse or pattern signals with excellent spectral purity.

Overview: Analog and Digital Sources**Function/Arbitrary/Vector Waveform Generators**

The E1441A Arbitrary Waveform Generator uses direct digital synthesis to deliver outstanding functionality, plus a wide range of built-in waveforms. It is the best price/performance VXI arbitrary generator on the market.

The E1445A Arbitrary Function Generator gives you the flexibility to produce virtually any waveform you need below 10 MHz. With this module, you can perform waveform and frequency hopping with its sweep and modulation functions, and have direct access to high-speed registers for waveform selection. And, you can program the E1445A using the industry-standard SCPI language.

The E2748A TIM-40-compatible vector waveform generator module is optimized for generating digitally modulated signals for communications applications, covering a frequency range of dc to six MHz. The modular structure of this product lends itself to the generation of multiple simultaneous signals of different or similar characteristics, producing a realistic signal environment for receiver testing.

The E1434A 4-Channel Arbitrary Source module provides a stimulus for mechanical, acoustical, and electrical testing. Its versatile synchronization and triggering capabilities make this module ideal for use with the E1432A and E1433B Digitizers.

Pulse/Pattern Generators

The E8311A and E8312A 2-channel Pulse/Pattern generators offer you accurate and versatile high-speed digital signals up to 330 MHz for use in a wide variety of applications. These include functional verification of high-speed digital devices, clock generation for synchronization of an automated test system, radar testing, and serial bus testing. These modules are functionally compatible with Agilent's standalone pulse generators (81110A), which are currently being used in many laboratories. This compatibility facilitates the transition of test routines from lab to production site.

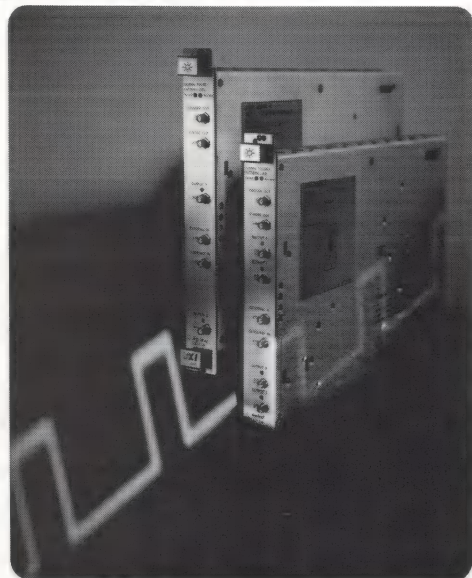
Additionally, the B-size VX462B Pulse Generator, available from C&H Technologies, Inc., rounds out the portfolio at the low end. If you need multiple and even higher-speed channels, please refer to the Agilent 81200 system in the *Agilent Test & Measurement Catalog*.

D/A Converters/Amplifiers

Two low-cost D/A converters are available for generating dc voltages and low-frequency waveforms, the B-size E1328A 4-Channel Digital-to-Analog Converter (DAC) and the C-size E1418A 8/16-Channel DAC. Both modules provide isolated outputs. These outputs may be connected in series or parallel for greater voltage or current output.

Pulse/Pattern Generators 165 MHz and 330 MHz

Agilent E8311A, E8312A



Agilent E8311A/E8312A

- 1-Slot, C-size, register based
- Two output channels
- 16 Kbit patterns per channel
- Fast transition times: 2 ns to 200 ms variable (E8311A), 0.8 ns or 1.6 ns selectable (E8312A)
- Functionally compatible with the 81110A
- Broad range of trigger and synchronization capabilities

Description

The Agilent Technologies E8311A and E8312A Pulse/Pattern Generators are C-size, 1-slot, register-based VXI modules. Both generators offer highly accurate digital signals up to 165 MHz/330 MHz respectively and feature two output channels. They are both shipped with VXIplug&play software drivers.

The generators can be used for a wide variety of applications, ranging from:

- Functional verification of high-speed digital or mixed-signal devices,
- Clock generation for synchronization of an automated test system,
- Radar testing,
- Serial bus testing,
- Flash memory testing.

The E8311A and E8312A Pulse/Pattern Generators can be easily integrated into all phases of test system development. They are functionally compatible (programming and features) with the 81110A. This compatibility facilitates the transition of test routines used in laboratories (handling R&D and quality test applications running on the 81100 family of box instruments) to the production site.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Pattern Mode

- **Pattern length:** 16 Kbit/channel and strobe output
- **Output format:** RZ (return to zero), NRZ (non-return to zero), DNRZ (delayed non-return to zero).
- **Random pattern:** PRBS 2^n-1 , $n = 7, 8, \dots, 14$.

Trigger Modes

- **Continuous:** Continuous pulses, double pulses, bursts (single or double pulses) or patterns.
- **External* triggered:** Each active input transition (rising, falling or both) generates a single or double pulse, burst or pattern.
- **External* gated:** The active input level (high or low) enables pulses, double pulses, bursts or patterns. The last single/double pulse, burst or pattern is always completed.
- **External* width:** The pulse shape can be recovered. Period and width of an external input signal is maintained. Delay, levels and transitions can be set.
- **Manual:** Simulates an external input signal.
- **Internal triggered:** Internal PLL or up-command replaces an external trigger source. Pulses, double pulses, bursts or patterns can be set.
- ***External:** Choice of sources as described under the "Inputs/Outputs" section.

Clock Generation

Synchronization of an automated test system can be realized by clock distribution with the new Agilent VXI pulse/pattern generators. Two channels combined with the 16-Kbit pattern capability supports even dual clock frequencies within the one module.

Variable delay ranges combined with a fixed trigger-in to signal-out delay allow synchronization even at precise points in time.

Reliable Measurements

Both models with their self-calibration provide clean, accurate pulses with excellent repeatability and reliability, thereby contributing to measurement integrity.

Glitch-free Timing Changes

Now you can sweep your timing values without the danger of spurious pulses or dropouts that could cause measurement errors. (Applies to continuous modes, values <100 ms, consecutive values between 0.5 and twice the previous value.)

Test Logic Technologies

The E8311A and E8312A Pulse/Pattern Generators generate all the standard pulses and digital patterns needed to test current logic technologies (CMOS, TTL, LVDS, ECL, etc.). Multi-level and multi-timing signals up to 60 MHz can be obtained using the internal channel addition feature.

Burst count: 2 to 65536 (single or double pulses).

Delay: Delay, phase or % of period.

Double pulse and delay: Mutually exclusive.

Duty cycle: Set between 0.1% and 95% (subject to width limits. 99.9% with overprogramming).

Transition times: Leading/trailing edge or % of width. Leading and trailing edges are independent (E8311A only) within one of the following overlapping segments (1:20 ratio):

- 2 ns (3 ns) – 20 ns
- 10 ns – 200 ns
- 100 ns – 2 ms
- 1 μ s – 20 μ s
- 10 μ s – 200 μ s
- 100 μ s – 2 ms
- 1 ms – 20 ms
- 10 ms – 200 ms

Output timing fidelity: Period, delay and width are continuously variable without any output glitches or dropouts.

Repeatability: Typically four times better than accuracy.

Level parameters: Voltage or current, high or low level, offset or amplitude.

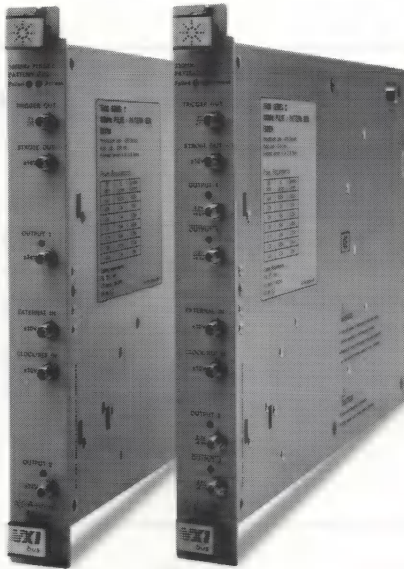
Load compensation: The individual load value can be entered (for loads $\neq 50 \Omega$) to output the actual values (only E8311A).

On/off: Relays connect/disconnect output (HiZ).

Normal/complement: Selectable.

Limit: Programmable high and low levels can be limited to protect the device-under-test.

(Agilent E8311A, E8312A continued)



Agilent E8311A and E8312A

Inputs and Outputs

Faceplate connector type: SMA

Connector for clock input or PLL reference input: The internal PLL is locked to an external 5 MHz or 10 MHz reference frequency. The output period is determined by the signal at clock input.

Connector for External input: Used for trigger, gate or external width. Choice of:

- Faceplate connector or
- 8 VXI backplane trigger lines (TTL)
- 2 VXI backplane trigger lines (ECL).

Input impedance: 50 Ω /10 k Ω selectable.

Threshold: -10 V to +10 V.

Max. input voltage: ± 15 Vp-p.

Sensitivity: ≤ 300 mVp-p typical.

Transitions: < 100 ns.

Frequency: dc to maximum frequency.

Minimum pulse width: 1.5 ns (as width of minimum external width mode).

Strobe Output and Trigger Output

Output selection:

Three choices:

- Faceplate connector or
- 8 VXI backplane trigger lines (TTL)
- 2 VXI backplane trigger lines (ECL).

Strobe output: User-defined, 16 Kbit pattern (NRZ) when in pattern mode.

Trigger format: One pulse per period with 50% duty cycle typical. External mode: 1.5 ns typical.

Level: TTL or ECL selectable.

Output impedance: 50 Ω typical.

Maximum external voltage: -2 V/+7 V.

Transition times: 1.0 ns typical for TTL, 600 ps typical for ECL.

Remote Control

Overprogramming: All parameters can be overprogrammed (exceeding specifications) to fully exploit the hardware limits.

Autoset: Resolves all timing conflicts.

Supported Computer Interfaces

- Agilent E8491B IEEE-1394 "FireWire" Slot-0 Command Module Controller: 300 MHz P-II
- Agilent E1406A GPIB Slot-0 Command Module. According to IEEE 488.2 SCPI Function Code: SH1,AH1,T6,L4, SR1,RL1,PP0,DC1,DT1,C0
- Agilent E9851A VXI Embedded PC, 700 MHz
- NI MXI-2 Slot-0 command module Controller: 300 MHz P-II
- NI embedded VXIpc-850

For more information, request a copy of the *Agilent Technologies' Family of Pulse/Pattern Generators* brochure, publication no. 5980-0489E.

Environmental Specifications

Operating temperature:	+ 5° C to + 40° C
Storage temperature:	- 40° C to + 70° C
Humidity:	35% – 95% rel. humidity up to 40° C ambient temperature
Altitude range:	Up to 12,000 m non-operating, up to 2,000 m operating
EMC:	Conforms to EN50082-1, EN 55011: 91, Class A; TCF B801356L
Safety:	Conforms to IEC1010-1, A1 + A2 + CSA, Class A, TCF
Pollution:	Degree 2
Installation:	Category II
Weight:	1.8 kg net, 2.7 kg shipped (E8311A) 1.6 kg net, 2.5 kg shipped (E8312A)
Recalibration period:	Three years recommended
Warranty:	3 years standard

Product Specifications

Timing Characteristics

	E8311A	E8312A
Frequency range:	1 mHz to 165 MHz	1 mHz to 330 MHz
From 1 k Ω : ^[1]	Up to 60 MHz typ.	N/A
Timing resolution:	3.5 digits, 5 ps best case	3.5 digits, 5 ps best case
RMS jitter (period, width, delay):		
With PLL:	0.001% \pm 15 ps	0.001% \pm 15 ps
With VCO: ^[2]	0.01% \pm 15 ps	0.01% \pm 15 ps
Period range:	6.06 ns to 999.5 s	3.03 ns to 999.5 s
Accuracy with PLL:	$\pm 0.01\%$ ($\pm 0.5\%$ typ. after self-cal., $\pm 3\%$ without self-cal.) ^[2]	$\pm 0.01\%$ ($\pm 0.5\%$ typ. after self-cal., $\pm 3\%$ without self-cal.) ^[2]
Width range:	3.03 ns to (period - 3.03 ns)	1.515 ns to (period - 1.515 ns)
Accuracy:	$\pm 0.5\%$ \pm 250 ps typ. ^[3] / $\pm 3\%$ \pm 250 ps ^[4]	$\pm 0.5\%$ \pm 250 ps typ. ^[3] / $\pm 3\%$ \pm 250 ps ^[4]
Add. variable delay range: ^[5]	0 ns to (period - 3.03 ns)	0 ns to (period - 3.03 ns)
Accuracy: ^[6]	$\pm 0.5\%$ \pm 0.5 ns typ. ^[3] / $\pm 3\%$ \pm 0.5 ns ^[4]	$\pm 0.5\%$ \pm 0.5 ns typ. ^[3] / $\pm 3\%$ \pm 0.5 ns ^[4]
Double pulse delay range:	(width + 3.03 ns) to (period - width - 3.03 ns)	(width + 1.5 ns) to (period - width - 1.5 ns)
Min. period:	12.2 ns (82 MHz) typ.	6.06 ns (165 MHz) typ.
Accuracy:	$\pm 0.5\%$ \pm 150 ps typ. ^[3] / $\pm 3\%$ \pm 150 ps ^[4]	$\pm 0.5\%$ \pm 150 ps typ. ^[3] / $\pm 3\%$ \pm 150 ps ^[4]
Transition time range (10/90):	2 ns to 200 ms variable	0.8 ns or 1.6 ns selectable
Minimum (with overprogramming):	≤ 2 ns/1.4 ns typ. for ECL levels (20/80) 5 ns typ. for 1 k Ω source impedance	≤ 600 ps for Vp-p ≤ 1 V 450 ps typ. for ECL levels (20/80) ≤ 900 ps for Vp-p > 1 V
Accuracy:	$\pm 10\%$ \pm 200 ps	$\pm 10\%$ \pm 200 ps
Linearity:	3% typ. for transitions > 100 ns	N/A

^[1] Source impedance is selectable from 50 Ω or 1 k Ω for the E8311A.

^[2] If the startable oscillator (VCO) is used (PLL not active).

^[3] After self-calibration.

^[4] Without self-calibration.

^[5] 0 ns to (period - 17.6 ns) in external width mode.

^[6] Changing of amplitude may add 0.5 ns.

Programming Times (all checks off)

(measured with an embedded VXI computer)

Command	Typical execution time
One parameter or mode	40 ms typ.
Recall setting	350 ms typ.
16 k pattern transfer	950 ms typ.

(Agilent E8311A, E8312A continued)

Typical Delays (E8311A) ⁽¹⁾

Instrument mode	From	To	Typ. value
External width:	EXT. INPUT	STROBE/TRIGGER OUT	9.0 ns
		OUTPUT 1/OUTPUT 2	18.0 ns
All other modes:	EXT. INPUT/CLK	STROBE/TRIGGER OUT	12.0 ns
	INPUT	OUTPUT 1/OUTPUT 2	24.0 ns
	STROBE/TRIGGER OUT	OUTPUT 1/OUTPUT 2	12.0 ns

⁽¹⁾ Subtract 4 ns from the typical delay value when referring to OUTPUT1/2 for the E8312A.

Level/Pulse Performance Characteristics

	E8311A	E8312A
Amplitude:		
50 Ω into 50 Ω :	100 m Vp-p to 10.0 Vp-p	100 m Vp-p to 3.8 Vp-p
1 k Ω into 50 Ω :	200 m Vp-p to 20.0 Vp-p	N/A
Level window:		
50 Ω into 50 Ω :	- 10.0 V to + 10.0 V	- 2.0 V to + 3.8 V
1 k Ω into 50 Ω :	- 20.0 V to + 20.0 V	N/A
Accuracy:		
50 Ω into 50 Ω :	\pm (1% + 50 mV)	\pm (2% + 50 mV)
1 k Ω into 50 Ω :	\pm (1% + 100 mV) [1]	N/A
Resolution:		
50 Ω into 50 Ω :	10 mV	10 mV
1 k Ω into 50 Ω :	20 mV	N/A
Output connectors:	SMA single-ended	SMA differential
Source impedance:	Selectable 50 Ω or 1 k Ω	50 Ω only
Accuracy:	\pm 1 % typ.	\pm 1 % typ.
Maximum external voltage:	\pm 24 V	- 2.2 V to + 5.5 V
Short circuit current:	\pm 400 mA max. (doubles for channel addition)	- 84 mA to + 152 mA
Dynamic crosstalk:	<0.1% typ.	<0.1% typ.
Baseline noise:	10 mV RMS typ.	4 mV RMS typ.
Overshoot/preshoot/ringing:	\pm 5% of amplitude \pm 20 mV	\pm 5% of amplitude \pm 50 mV

⁽¹⁾ In \pm 19 V level window.

Channel Addition

VXI Module	E8311A
Amplitude:	
50 Ω into 50 Ω :	100 m Vp-p to 20.0 Vp-p
1 k Ω into 50 Ω :	200 m Vp-p to 20.0 Vp-p
Source impedance:	Selectable from 50 Ω or 1 k Ω
Level window:	
50 Ω into 50 Ω :	- 20.0 V to + 20.0 V
1 k Ω into 50 Ω :	- 20.0 V to + 20.0 V
Max. frequency:	
50 Ω channel:	60 MHz typ.
1 k Ω channel:	15 MHz typ.
Min. transitions:	
50 Ω channel:	2 ns typ. (channel one), 5 ns typ. (channel two)
1 k Ω channel:	20 ns typ. both channels

Note: The E8312A does not feature channel addition.

General Specifications

VXI Characteristics

VXI device type:	Register based
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	none
VXI buses:	TTL/ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website

(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	No
Command module firmware rev:	n/a
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

	E8311A	E8312A
Watts/slot:	87 VA max.	50 VA max.
ΔP mm H₂O:	0.55	0.35
Air Flow liter/s:	5.1 for 15° C rise	2.8 for 15° C rise

Module Current

	I_{PM} (A)		I_{DM} (A)	
	E8311A	E8312A	E8311A	E8312A
+5 V:	1.8	1.6	0.05	0.05
+12 V:	1.1	0.9	0.25	0.05
-12 V:	0.9	0.8	0.05	0.05
+24 V:	1.1	0.07	0.6	0.01
-24 V:	1.1	0.02	0.6	0.01
-5.2 V:	5.0	5.0	0.1	0.1
-2 V:	0.6	0.35	0.05	0.02

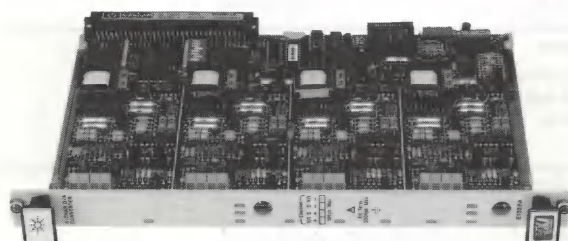
Ordering Information

Description	Product No.
165 MHz VXI Pulse/Pattern Generator	E8311A
MIL Std. 45662A Calibration w/Test Data	E8311A IBP
Commercial Calibration Certificate	E8311A UK6
3 Year Customer Return to Agilent Calibration Service	E8311A W32
3 Year MIL Calibration Service	E8311A W34
5 Year Customer Return to Agilent Repair Service	E8311A W50
5 Year Customer Return to Agilent Commercial Calibration Service	E8311A W52
5 Year Customer Return to Agilent Standard Compliant Calibration Service	E8311A W54
330 MHz VXI Pulse/Pattern Generator	E8312A
MIL Std. 45662A Calibration w/Test Data	E8312A IBP
Commercial Calibration Certificate	E8312A UK6
3 Year Customer Return to Agilent Calibration Service	E8312A W32
3 Year MIL Calibration Service	E8312A W34
5 Year Customer Return to Agilent Repair Service	E8312A W50
5 Year Customer Return to Agilent Commercial Calibration Service	E8312A W52
5 Year Customer Return to Agilent Standard Compliant Calibration Service	E8312A W54
Printed English Installation Guide (if ordered separately)	E8311-91010
English Quick Start Guide, including VXIplug&play drivers and service manual, on CD (if ordered separately)	E8311-10010
Pulse Adder/Splitter	15104A

Publication No.: 5968-5814E

4-Channel D/A Converter

Agilent E1328A



Agilent E1328A

- 1-Slot, B-size, register based
- Four isolated voltage or current DACs
- ± 10.92 V or ± 21.8 mA output
- Software calibration
- Remote voltage sensing with *no-fault* operation
- Multiple channels connected in series/parallel

Description

The Agilent Technologies E1328A 4-Channel D/A Converter is a B-size, 1-slot, register-based VXI module. It has four independent, isolated digital-to-analog channels configurable for either dc voltage or dc current output. Remote voltage sensing is available with no-fault operation.

All four channels are independently isolated and may be floated up to 350 Vdc from ground. Multiple channels may be connected in series or in parallel to increase the voltage or current range (to 48 V or 96 mA using a single module). The D/A converter can be calibrated through software commands. You can use this module in a system with a 5.5-digit multimeter (E1326B or equivalent) and multiplexer. Then, the system can be programmed to automatically calibrate the D/A outputs to 24-hour specifications each day. This product may be adapted for use in a C-size mainframe.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

C-size Adapter

This product may be adapted for use in a C-size mainframe. See the E1403C Adapter description.

Product Specifications

dc Voltage

Amplitude:	± 10.92 Vdc max (cal on), ± 12 Vdc max. (cal off)
Resolution:	16 bits (cal off) 333 μ V programming interval (cal on) Monotonic to 2 mV
Amplitude accuracy (dc): (cal on, within $\pm 5^\circ$ C of cal temperature and same load as at cal)	
24-hour:	$\pm (0.05\%$ of output + 3.3 mV)
90-day:	$\pm (0.15\%$ of output + 29 mV)
Output current:	
Compliance current:	24 mA
Short circuit current:	≤ 30 mA
Differential ripple and noise:	<2 mV rms (20 Hz–250 kHz, 1 k Ω load)

dc Current

Range:	± 21.8 mA (cal on) ± 24.0 mA (cal off)
Resolution:	667 nA programming interval (cal on), 16 bit resolution (cal off) Monotonic to 4 μ A
Accuracy: (cal on, within $\pm 5^\circ$ C of cal temperature and same load as at cal)	
24-hour:	$\pm (0.05\%$ of output + 7 μ A)
90-day:	$\pm (0.15\%$ of output + 59 μ A)
Output voltage:	
Compliance voltage:	13 V
Max open circuit voltage:	≤ 19 V
Differential ripple and noise:	<4 μ A rms (20 Hz - 250 kHz, into 100 Ω)

General Specifications

Settling time:	750 μ s (cal on), 500 μ s (cal off) (single channel, to rated accuracy)
Isolation:	250 V rms, 350 Vdc/ac pk (channel-to-channel or chassis)
Max wire size:	16 AWG (1.5 mm)

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A16, D16 DTB Slave
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	n/a
VXI buses:	n/a
C-size compatibility:	Yes

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	ROM
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.4	0.02
+12 V:	0.5	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	6.50
ΔP mm H₂O:	0.11
Air Flow liter/s:	0.52

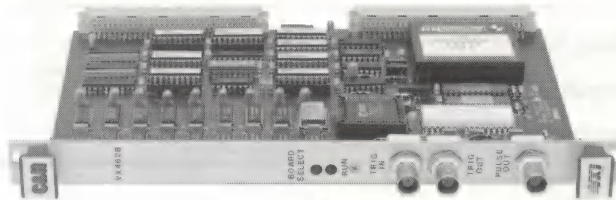
Ordering Information

Description	Product No.
4-Channel D/A Converter	E1328A
Service Manual	E1328A 0B3
Japan - Japanese Localization	E1328A ABJ
3 yr Retn. to Agilent to 1 yr. OnSite Warr.	E1328A W01

Publication No.: 5965-5532E

Pulse Generator

VX462B (Referenced Product)



VX462B

- 1-Slot, B-size, register based
- 20 MHz pulse
- 40 MHz square wave capacity
- Flexible triggering
- VXIplug&play compatible

Description

The VX462B 20 MHz Pulse Generator is a B-size, 1-slot register-based VXI module. It has an additional 40 MHz square wave capacity. Its operating modes are Normal, Triggered, Gated, Delayed Pulse, and Double Pulse (second pulse occurs "delay" time after Trigger Out). Front panel BNC connectors are provided for Pulse Out, Trigger Out, and Trigger (and Gate) In. LED indicators are provided for ACCESS, MODID and RUN.

Applications for this module include pulse generator, square wave generator, clock source, and delayed trigger.

Refer to the C&H Technologies Website for instrument driver availability and user's manual (www.chtech.com).

This product is referenced by Agilent Technologies. It is manufactured and sold by C&H Technologies, Inc. Agilent does not sell, distribute, warrant, or support this product.

For more information contact:

C & H Technologies, Inc.
Round Rock, TX, U.S.A.
Telephone: 800-638-9948
www.chtech.com

Applications

- Pulse generator
- Square wave generator
- Clock source
- Delayed trigger

Product Specifications

Pulse Specifications

Pulse repetition interval:	
Range:	50 ns to 1 s
Resolution:	10 bits, 25 ns min
Accuracy:	± 15 ns
Pulse width:	
Range:	25 ns to 1 s
Resolution:	25 ns min
	10 bits
Accuracy:	± 15 ns

Output Amplitude

Amplitude:	± 10 V into 50 Ω
Amplitude accuracy (ac):	± 1% Pgm value, ± 3% of amplitude, ± 100 mV
Amplitude accuracy (dc):	Not specified

Auxiliary Input/Output

Delay timing (from Trig Out):

Range:	25 ns to 1 s
Resolution:	10 bits, 25 ns min
Accuracy:	± 15 ns
Trigger/gate in:	TTL

Environmental

Operating temperature:	0 to +50° C
Storage temperature:	-40 to +65° C

Power Requirements

I_{MP} at +5 V:	3.0 A typical
I_{MP} at +12 V:	0.4 A typical

Waveforms

Arbitrary waveform function:	No
Standard waveforms:	Square, pulse
Modulation:	No
Sweep:	No

VXIbus Compliance

Complies with ANSI/IEEE Std. 1014-1987 and VXIbus Rev. 1.4

No SYSFAIL

No Interrupts

IACKIN tied to IACKOUT

BRX tied to BGX

Built-in test via feedback registers

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A16, D16 DTB Slave
Size:	B
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	n/a
C-size compatibility:	Yes, with the Agilent E1403A Adapter

Instrument Drivers - See the C&H Technologies Website (<http://www.chtech.com>) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	No
C-SCPI Series 700:	Yes
Panel Drivers:	Contact Vendor for availability
VXIplug&play Win Framework:	Yes
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	Contact Vendor for availability

Cooling/Slot

Watts/slot:	12.10
ΔP mm H₂O:	n/a
Air Flow liter/s:	1.00

Ordering Information

Description	Part No.
Pulse Generator	VX462B 11026335

Order from:

C & H Technologies, Inc. (U.S.A.)
445 Round Rock West Drive
Round Rock, TX 78681-5012
Telephone: (800) 638-9948
Fax: (512) 733-2629
www.chtech.com

Note: This product cannot be ordered from Agilent Technologies.

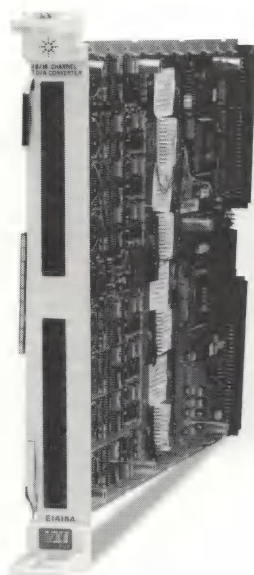
Referenced Product

The information for this product has been provided by C&H Technologies, Inc. Agilent Technologies disclaims any and all liabilities for and makes no warranties, expressed or implied, with respect to these products, including without limitation the implied warranties of merchantability and fitness for a particular purpose. Providing information concerning these products does not constitute Agilent's endorsement of the products, C&H Technologies, Inc., or its support services.

Publication No.: Not available

8/16-Channel D/A Converter

Agilent E1418A



Agilent E1418A

- 1-Slot, C-size, register based
- 8/16 independent channels, flexible and configurable
- Individual isolation per channel
- 16-bit resolution D/A per channel
- Programmable selectable voltage/current modes
- Software controlled calibration

Description

The Agilent Technologies E1418A 8/16-Channel D/A Converter is a C-size, 1-slot, register-based VXI module. It consists of 8 or 16 fully independent, isolated or non-isolated, 16-bit D/As. Each channel can be set to voltage or current mode with local or remote sensing on voltage outputs. All outputs can be updated with register-level programming to allow fast backplane access. Each channel can be updated individually, or by using the internal data buffer, synchronized so that all channels change simultaneously. The channel output mode is set with jumpers in the terminal block for each channel or by register programming. Each D/A converter can be calibrated without removal through software commands and use of the terminal block CALBUS in conjunction with a 5.5-digit multimeter. The on/off terminal block has standard screw terminals for field wiring.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Fast Updates

All outputs can be updated with register-level programming to allow fast backplane access. Rates are limited by controller speed and analog settling time. Each channel can be updated individually, or by using the internal data buffer, synchronized so that all channels change at the same time. The channel output mode is set with jumpers in the terminal block for each channel or by register programming.

In-place Calibration

Each D/A converter can be calibrated without removal through software commands and use of the terminal block CALBUS in conjunction with a 5.5-digit multimeter. In addition, a built-in self-test command provides a high level of confidence that the module is operating properly.

Choice of Connectors

The easy-to-use on/off terminal block, a feature of QUIC, has standard screw terminals for field wiring. Optional crimp and insert or ribbon cable connectors are available. Each channel contains a programmable output disconnect relay to open or close the channel.

Product Specifications

dc Voltage

Amplitude:	± 16 V max.
Resolution:	16 bits (488 μ V steps) Monotonic to 2.0 mV
Amplitude accuracy (dc):	$\pm (0.05\% + 3.0$ mV) (90 days)

dc Current

Range:	0 to ± 20.00 mA
Resolution:	16 bit (610 nA steps) Monotonic to 25 μ A
Accuracy:	\pm (% value + amps) (calibrated; temperature within $\pm 5^\circ$ C of calibration temperature and same load as at calibration)
90-day:	$\pm (0.09\% + 5.0$ μ A)

Output voltage:

Compliance voltage:	± 12 V
Max open circuit voltage:	<18 V

Output current:

Compliance current:	>20 mA @ 0 to ± 12 V derated linearly to 5 mA @ ± 16 V
Short circuit current:	<40 mA

Differential ripple and noise: <2 μ A rms (20 Hz - 250 kHz, into 250 Ω load)

ac Output

Sample rate:	1 kSa/s per channel
Modulation:	No
Sweep:	No
Amplitude accuracy (ac):	not specified
Standard waveforms:	No
Arbitrary waveform function:	No

General Characteristics

Settling time:	300 μ s (+ full scale to - full scale step, single channel, to rated accuracy)
Isolation:	42 Vdc/ac peak (channel-to-chassis or channel-to-channel)
Synchronization:	Software commands, external trigger inputs, or TTL backplane trigger lines provide a choice of synchronizing event. Each individual channel can be updated by software command or all channels can be updated at the same time based upon a software or hardware trigger.

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A16 or A24, D16
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	n/a

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	No
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

(Agilent E1418A continued)

Module Current

	I_{PM}	I_{DM}
+5 V:	0.7	0.01
+12 V:	0.04	0.01
-12 V:	0	0
+24 V:	0.44	0.01
-24 V:	0.44	0.01
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	25.4
ΔP mm H ₂ O:	0.10
Air Flow liter/s:	2.00

Ordering Information

Description	Product No.
8/16-Channel D/A Converter	E1418A
Add 8 Channels for total of 16, Non-isolated***	E1418A 001***
Convert 8 Channels to Isolated***	E1418A 002***
Add 8 Channels and convert all 16 to Isolated***	E1418A 003***
Crimp/Insert Connectors****	E1418A A3E****
Ribbon Cable Connectors	E1418A A3H
3 yr Retn. to Agilent to 1 yr. OnSite Warr.	E1418A W01
1-Channel Isolation Plug-on for E1418A*	E1523A*
8-Non-Isolated-Channel Expan. Kit for E1418A**	E1524A**
8-Isolated-Channel Expan. Kit for E1418A**	E1525A**

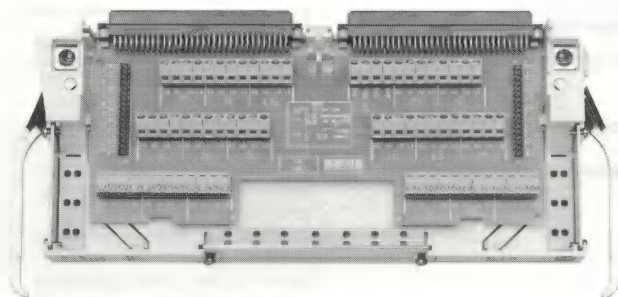
Notes:

* You can add isolation to single channels with the E1523A.

** You can add an 8-channel expansion kit to existing 8-channel units with the E1524A and E1525A.

*** Factory-installed option. *Must* be ordered with the E1418A.

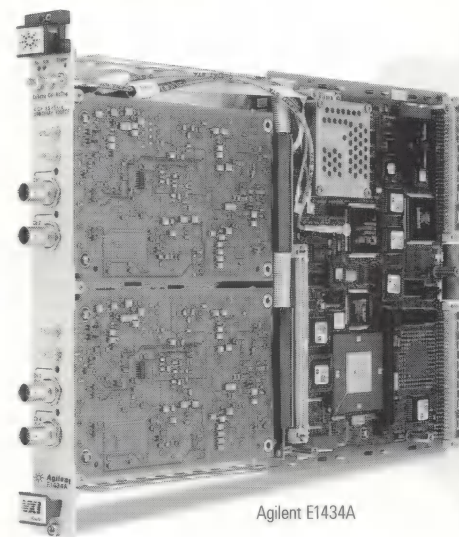
**** Crimp-and-insert contacts are not included. See the Interconnect and Wiring section for information on ordering Crimp-and-Insert Contacts.



Publication No.: 5965-5534E

4-Channel 65 kSa/sec Arbitrary Source

Agilent E1434A



Agilent E1434A

- 1-Slot, C-size, register based
- 16-bit resolution with 25.6 kHz bandwidth (4-channel)
- 20-bit resolution with 6.4 kHz bandwidth (2-channel)
- Built-in sine and random waveforms
- Continuous arbitrary waveforms of any length
- Optional 5th source channel available

Description

The Agilent Technologies E1434A 4-Channel Arbitrary Source is a C-size, 1-slot, register-based VXI module. It provides stimulus for mechanical, acoustical, and electrical testing. This module can be used as four 16-bit sources with 25.6 kHz bandwidth, or as two 20-bit sources with 6.4 kHz bandwidth. The 20-bit mode is useful for applications where the extra headroom allows smooth output level changes over a wide amplitude range. Versatile synchronization and triggering capabilities make this module ideal for use with the E1432A and E1433B Digitizers.

Built-in sine and random noise waveforms save development time, and offload computations and data movement chores from the host computer.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

High-Performance Architecture

Most simple DACs require the host computer to create waveforms and download them to the DAC. By computing its own sine and random noise waveforms the E1434A offloads work from the host computer, preventing it from becoming a system performance bottleneck.

Sine and Noise Waveforms

Sinewaves are one of the most common test waveforms. The E1434A provides four independent channels of sinewave capability, each with its own frequency, phase, and amplitude. Sinewaves can be continuous or burst waveforms, with frequencies from zero to 25.6 kHz.

The E1434A's noise capabilities are exceptional. It provides periodic and pseudo random waveforms, in either continuous or burst mode. Additionally, the E1434A can band-translate the noise to have a non-zero start frequency. This allows you to pinpoint the noise stimulus to frequencies of interest, avoiding troublesome resonances or frequencies that might damage the device under test.

(Agilent E1434A continued)

Arbitrary Waveforms

Use arbitrary waveforms to provide almost any stimulus you can imagine. Arbitrary waveforms can be downloaded from the host computer and then output in a repeating loop. Or the host can continuously download new segments of a waveform to be concatenated with previous segments, allowing continuous, glitch-free playback of any length waveform.

Variable Resolutions

The E1434A can be used as four 16-bit sources with 25.6 kHz bandwidth, or as two 20-bit sources with 6.4 kHz bandwidth. The two modes are selectable by software. 20-bit mode is useful for applications where the extra headroom allows smooth output level over a wide amplitude range.

Channels Come in Pairs

The four output channels are grouped in pairs. Both channels of a pair must output the same type of waveform—sine, random, or arbitrary. But each pair of channels is completely independent from the other pair. For example, one channel pair could output two uncorrelated random noise signals while the other channel pair output two different sinewaves. Option 1DM deletes a pair of channels, making the E1434A a two-channel source.

Add a Fifth Channel

Adding Option 1D4 provides an additional arbitrary source that has the same capabilities, waveform types, and specifications as the standard source channels. It can be used as a 20-bit 6.4 kHz source or a 16-bit 25.6 kHz source. A built-in analog summer input allows another signal, possibly from one of the four output channels, to be summed to the fifth channel output.

Safety Features

Since arbitrary sources can drive very expensive devices under test, it is important to provide an orderly shutdown in case of emergency. In addition to programmable ramp-up and ramp-down rates, the E1434A has a smooth ramp-down from ac power failure, or in response to its emergency shutdown input.

For More Information

E1432A, E1433B, E1434A Product Overview, pub. no.: 5968-7086E;
E3242A Product Overview, pub. no.: 5966-3060E;
E3243A Product Overview, pub. no.: 5966-3061E;
E1434A Technical Specifications, pub. no.: 5963-9654E;
E1434A Photo Card, pub. no.: 5964-9073E.

Product Specifications**Output Characteristics (General)**

Sample rate:	65 kSa/s per channel
Resolution:	20 bits (2 channels) 16 bits (4 channels)
Amplitude:	10 Vpk max.
Full scale output ranges:	80 mVpk to 10 Vpk (0.375 dB steps)
Output impedance:	0.5 Ω
Maximum output current:	100 mA
Maximum load capacitance:	0.01 μ F
Amplitude ramp-down time:	0 to 30 seconds (programmable)

Emergency Shutdown

Shutdown input:	TTL
Shutdown time:	<5 s
ac failure shutdown:	<4 ms

Sine frequency

Frequency range:	0 to 25.6 kHz
Frequency resolution:	
Sine freq. \leq 1 kHz:	244 μ Hz
1 kHz < sine freq. \leq 10 kHz:	2.384 mHz
10 kHz < sine freq. \leq 25.6 kHz:	6.1 mHz
Amplitude accuracy (ac)	
1 kHz sine wave:	$\pm 2.3\%$ (± 0.2 dB) [10 to 0.158 Vp, 1 kHz]
Amplitude accuracy (low level):	$\pm 4.7\%$ (± 0.4 dB) [152 to 80 mVpk, 1 kHz]
Amplitude accuracy (dc):	Not specified
Flatness relative to 1 kHz:	$\pm 5.5\%$ (± 0.5 dB)
Standard waveforms:	Sine Burst sine

Noise Output Mode

Noise output types:
Pseudo random: Burst and mooz*
Periodic random: Burst and mooz
*Mooz is band-translated noise, i.e. noise with a non-zero start frequency.

Selectable noise bandwidth:
Frequency spans: 25.6 kHz to 0.4 Hz
Mooz spans: 2 kHz to 156 mHz
Max mooz center frequency: < 4 kHz
(spans and center frequencies match the E1432A/33B)

Arbitrary Output Mode:
Arbitrary waveform function: Yes
Arbitrary output modes: Continuous Loop
Maximum signal bandwidth:
20 bits (2 channels only): 6.4 kHz
16 bits (4 channels): 25.6 kHz
Dual-RAM buffer size: 40,960 samples/buffer

Constant Level Output

Output level: 1 Vpk
Output impedance: 1.2 k Ω (typical)
Flatness:
5 Hz to 20 kHz, amplitude scale factor 0.1 to 1.0: 1.13 Vp to 0.88 Vp (± 1 dB) typ.
5 Hz to 20 kHz, amplitude scale factor 0.01 to 1.0: 1.13 Vp to 0.44 Vp (+10, -7 dB) typ.
Residual dc offset: <5 mV (typ)

Triggering/Synchronization

Triggering types: E1432A/33B input, external, source, TTL TRG, software
Synchronization: E1432A, E1433B, and E1434A sample rates and triggering can be synchronized across multiple modules and mainframes.

Amount of RAM

DRAM:
(none required for sine, noise, or continuous arbitrary source output mode)
Standard: 0 MB
Optional: 4 MB, 32 MB

General Specifications**VXI Characteristics**

VXI device type: Register based
Data transfer bus: A16, A32, D32 slave only
Size: C
Slots: 1
Connectors: P1
Shared memory: No
VXI buses: Local Bus A, C; TTL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading

Command module firmware: No
Command module firmware rev: n/a
I-SCPI Win 3.1: No
I-SCPI Series 700: n/a
C-SCPI LynxOS: No
C-SCPI Series 700: C Libraries
Panel Drivers: No
VXIplug&play Win Framework: No
VXIplug&play Win 95/NT Framework: Yes
VXIplug&play HP-UX Framework: Yes

Module Current

E1434A	I_{PM}	I_{DM}
+5 V:	4.9	0.03
+12 V:	0.6	0.04
-12 V:	0.55	0.05
+24 V:	0.02	0.01
-24 V:	0.025	0.01
-5.2 V:	0.6	0.03
-2 V:	0.03	0.01

(Agilent E1434A continued)

E1434A Opt 1D4	I _{PM}	I _{DM}
+5 V:	0.6	0
+12 V:	0.19	0
-12 V:	0.18	0
+24 V:	0.03	0
-24 V:	0.03	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	52.28
ΔP mm H ₂ O:	0.32
Air Flow liter/s:	4.3

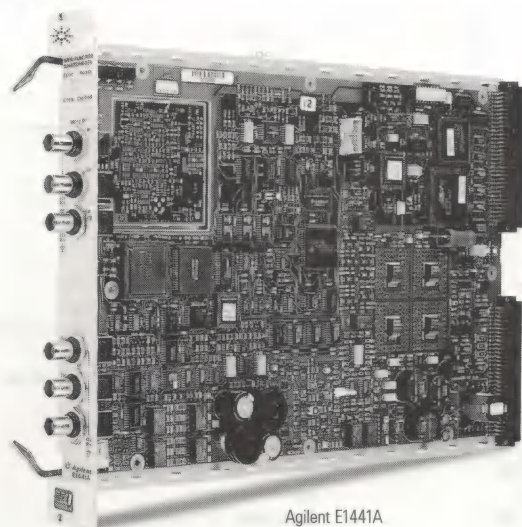
Ordering Information

Description	Product No.
4-Channel 65 kSa/s Arbitrary Source	E1434A
Delete Manual Set	E1434A 0B0
Add Manual Set	E1434A 0B1
Mil Std 45662A Calibration w/Test Data	E1434A 1BP
Arbitrary Source	E1434A 1D4
Delete 2 Output Channels	E1434A 1DM
32 MB Total RAM	E1434A ANC
4 MB Total RAM	E1434A ANM
Add Local Bus Interface	E1434A UGV
Commercial Cal. Certificate w/Test Data	E1434A UK6
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1434A W01

Publication No.: 5963-9654E

Arbitrary Waveform Generator

Agilent E1441A



Agilent E1441A

- 12-bit, 40 MSa/s, four 16k-deep arbitrary waveforms
- 15 MHz sine- and square-wave outputs
- Includes sine, square, triangle, ramp, noise, and more
- Internal lin/log sweep plus AM/FM/FSK/Burst modulation
- Isolated output
- Optional high-stability timebase and external phase lock

Description

The Agilent Technologies E1441A Arbitrary Waveform Generator is a C-size, 1-slot, message-based VXI module. It uses direct digital synthesis to deliver outstanding functionality at a price far below comparable, rival arbitrary function generators.

Standard built-in waveforms include sine, square, triangle, ramp, noise, $\sin(x)/x$, exponential rise & fall, cardiac, and DCV. With the E1441A, you can also design your own arbitrary waveform. Standard features include internal AM/FM/FSK/Burst modulation and both linear and logarithmic sweep. The output from the E1441A is isolated from earth ground so that ground loops or other common mode noise are minimized.

With Option 001, the E1441A provides high-stability timebase and external phase lock. This option adds 0.1 ppm/month frequency stability plus phase lock to an external reference or phase lock two or more E1441A's together.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Waveforms

Built-in waveforms: Sine, square, triangle, ramp, noise, DCV, $\sin(x)/x$, negative ramp, exponential rise, exponential fall, cardiac

Arbitrary waveform:
 Length: 8 to 16,000 points
 Resolution: 12 bits (including sign)
 Sample rate: 40 MSa/s
 Non-volatile memory: Four (4) 16k waveforms

Frequency Characteristics

Sine: 100 μ Hz - 15 MHz
Square: 100 μ Hz - 15 MHz
Triangle: 100 μ Hz - 100 kHz
Ramp: 100 μ Hz - 100 kHz
Noise (Gaussian): 10 MHz bw
Waveforms (points):
 8 to 8,192: 100 μ Hz - 5 MHz
 8,193 to 12,287: 100 μ Hz - 2.5 MHz
 12,288 to 16,000: 100 μ Hz - 200 kHz
 10 μ Hz or 10 digits

Resolution accuracy (18 to 28° C):

90 days: 10 ppm
 1 year: 20 ppm
Temperature coefficient: <2 ppm/°C
Aging: <10 ppm/yr

Sinewave Spectral Purity

Harmonic distortion:
 dc to 20 kHz: <-70 dBc
 20 kHz to 100 kHz: <-60 dBc
 100 kHz to 1 MHz: <-45 dBc
 1 MHz to 15 MHz: <-35 dBc
Total harmonic distortion:
 dc to 20 kHz: <0.04%
Spurious (non-harmonic):
 Output (dc to 1 MHz): <-65 dBc
 Output (>1 MHz): <-65 dBc + 6dB/octave
Phase noise: <-52 dBc in a 30 kHz band

Signal Specifications

Square wave:
 Rise/fall time: <20 ns
 Overshoot: <4%
 Asymmetry: <1% + 5 ns
 Duty cycle: 20% to 80% (to 5 MHz), 40% to 60% (to 15 MHz)
Triangle, ramp, arbitrary:
 Rise/fall time: <100 ns (typical)
 Linearity: <0.1% of peak output
 Settling time: <250 ns to 0.5% of final value
 Jitter: <25 ns

(Agilent E1441A continued)

Output Characteristics

Note: Add 1/10th of output amplitude and offset specification per °C for operation outside of 18° C to 28° C range.

Amplitude (into 50 Ω): 50 mVp-p to 10 Vp-p, 100 mVp-p to 20 Vp-p into open-circuit load
± 1% of specified output

Accuracy (at 1 kHz):

Flatness (sine wave relative to 1 kHz):

<100 kHz: ± 1% (0.1 dB)
100 kHz to 1 MHz: ± 1.5% (0.15 dB)
1 MHz to 15 MHz: ± 2% (0.2 dB)

Offset (into 50 Ω):

(**Note:** Offset $\leq 2X$ peak-to-peak amplitude) ± 5 Vpk ac + dc

Accuracy (For square wave outputs, add 2% of output amplitude additional error):

± 2% of setting + 2 mV

Output impedance:

50 Ω fixed

Resolution: 3 digits, amplitude and offset

Output units: Vp-p, Vrms, dBm

Isolation: 42 Vpk maximum to earth

Protection: Short-circuit protection, ± 15 Vpk overdrive <1 minute

Modulation Specifications

AM modulation:

Carrier (3 dB frequency): 15 MHz (typical)

Modulation: Any internal waveform plus arbitrary
Frequency: 10 mHz to 20 kHz ($\pm 0.05\%$ to 2.5 kHz, then decreases linearly to $\pm 0.4\%$ at upper limit)

FM modulation:

Modulation: Any internal waveform plus arbitrary
Frequency: 10 mHz to 10 kHz ($\pm 0.05\%$ to 600 Hz, then decreases linearly to $\pm 0.8\%$ at upper limit)

Peak deviation: 10 mHz to 15 MHz

Source: Internal only

Burst modulation:

Carrier frequency: 5 MHz max.

Count: 1 to 50,000 cycles, or infinite

Start phase: -360° to $+360^\circ$

Internal rate: 10 mHz to 50 kHz $\pm 1\%$

Gate source: Internal or external gate

Trigger source: Single, external, or internal rate

FSK modulation:

Frequency range: 10 mHz to 15 MHz ($\pm 0.05\%$ to 600 Hz, then decreases linearly to $\pm 4\%$ at upper limit)

Internal rate: 10 mHz to 50 kHz

Source: Internal/external (1 MHz max.)

Internal rate: 10 mHz to 50 kHz $\pm 1\%$

Auxiliary Inputs

External AM modulation: ± 5 Vpk = 100% modulation

Input resistance: 5 k Ω nominal

Ext. trigger/FSK/Burst rate (Trigger source ignored when External Gate is selected):

TTL (high true)

Latency: 1.3 μ s

Jitter: 25 ns

VXI TTL Trigger/FSK/

Burst rate: TTL (low true)

Latency: 1.15 μ s

Jitter: 25 ns

General Characteristics

Configuration times: Time to change parameter and output the new signal

Function change (Modulation or sweep off): 80 mS

Frequency change (Modulation or sweep off): 30 mS

Amplitude change: 30 mS

Offset change: 20 mS

Modulation parameter change: <350 mS

Select user arbitrary: 550 mS

Warm-up time: 30 min

Arbitrary waveforms: Stored separately

User-configurable stored states: 4

Option 001 Phase Lock/TCXO Timebase

Description: Adds high stability reference, phase lock to second E1441A and control phase offset

Stability: ± 1 ppm, 0 to 50° C

Aging: <2 ppm/month in first 30 days, 0.1 ppm/month after 30 days

Ext. ref. input lock range: 10 MHz ± 50 Hz

Phase offset: -360° to $+360^\circ$, 0.001° resolution

General Specifications**VXI Characteristics**

VXI device type: Message based

Data transfer bus: A16, slave only

Size: C

Slots: 1

Connectors: P1/P2

Shared memory: No

VXI buses: No

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Not required, message based

Command module firmware rev: Not required, message based

I-SCPI Win 3.1: Not required, message based

I-SCPI Series 700: Not required, message based

C-SCPI LynxOS: Not required, message based

C-SCPI Series 700: Not required, message based

Panel Drivers: No

VXIplug&play Win Framework: No

VXIplug&play Win 95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.5 A	0.10 A
+12 V:	2.5 A	0.12 A
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot: 25.0

ΔP mm H₂O: 0.1

Air Flow liter/s: 2.0

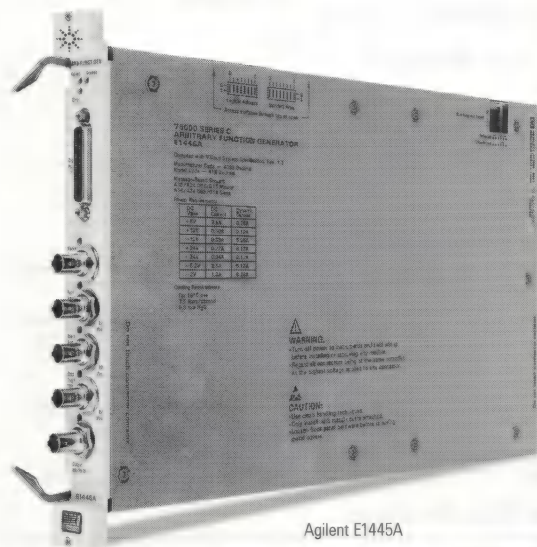
Ordering Information

Description	Product No.
Arbitrary Waveform Generator	E1441A
Phase Lock/TCXO Timebase	E1441A 001
ANSI Z540 Compliant Calibration	E1441A A6J
3 yr. Retn. to Agilent to 1yr. OnSite Warr.	E1441A W01

Publication No.: 5965-8830E

Arbitrary Function Generator

Agilent E1445A



Agilent E1445A

- 1-Slot, C-size, message based
- 13-bit resolution, 40 MSa/s
- 256 kSa waveform segment memory
- Waveform and frequency hopping with sweep function
- Direct access to high-speed registers
- Built-in self-test

Description

The Agilent Technologies E1445A Arbitrary Function Generator is a **C-size, 1-slot, message-based VXI module**. It provides the flexibility to produce virtually any waveform needed.

The deep memory allows downloading a large number of waveforms at once, and can store up to 128 waveforms using SCPI programming. The memory sequencer lets you link waveform segments together in any order. These sequences can be repeated 1 to 64 k times or continuously. Within a sequence, the segments can be repeated up to 4,096 times using only one sequence memory entry. This memory structure lets you build large, complex waveforms out of small segments.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Produce Complex Waveforms

Essentially, there are two memories built into the E1445A:

1. 256 kSa segment memory that supplies the digital-to-analog converter (DAC) with its output values; and
2. 32 k-segment sequence memory that defines how the segments are consecutively linked together at full speed.

The memory sequencer lets you link waveform segments together in any order. These sequences can be repeated 1 to 64 k times or continuously. Within a sequence, the segments can be repeated up to 4,096 times using only one sequence memory entry. This memory structure lets you build large, complex waveforms out of small segments.

Precisely Control the Frequency

One of the clocks is created by the Direct Digital Synthesis (DDS) technique. With DDS, you get very high resolution. This allows you to precisely set the frequencies you need.

For signals with the lowest phase noise, crystal oscillators with divider circuits are also on-board to clock the DAC. This allows you to set values like 20 MSa/s with minimal jitter.

Hop Frequencies

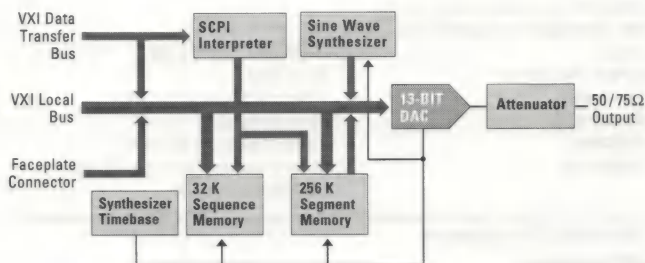
Frequency hopping is done easily by programming a list of frequencies and instructing the internal microprocessor to step through the list. As an added benefit, the frequency changes are phase continuous. Using this feature, you can produce bursts of several tones.

Drive the DAC Directly

When you have an extremely long or indeterminate waveform, you can use the VXI Local Bus or the faceplate connector to drive the DAC directly. This lets your process define the waveform being produced by the E1445A. Local Bus speed is limited to 7.4 MSa/s typical. Neither is paced by the internal time base, they must be paced externally.

Control and Synchronize Other Instruments

A programmable marker places a pulse on the Marker Out BNC. This marker can appear in any location in the segment memory. You can use the marker to synchronize other instruments, such as an oscilloscope or a digital functional tester.



Product Specifications

Waveforms

Arbitrary waveform function:	Yes
Standard waveforms:	Sine, square, ramp, and triangle
Resolution:	13 bits (12 bits for sine)
Sample rate generation method:	Direct digital synthesis (DDS) or time base sources with digital dividers

Sample rate using DDS*

Mode	Resolution	Range (Sa/s)
DDS normal	0.01 Sa/s	0.01 to 10.7 M
DDS doubled	0.02 Sa/s	0.02 to 21.4 M

* Internal 42.94 MHz crystal

Sample rate:

(Resolution using non-DDS timebase)
(time base frequency)/(divider),
divider = 1, 2, 3, 2N (N = 1 to 64 k),
max. 40 MSa/s

Waveform segment memory:

Maximum number of segments:

256 kSa
256 using SCPI

Sequence memory:

32,768 segments

Maximum number of waveforms in memory:

128 using SCPI

Waveform sequence looping (burst output mode):

1 to 65,536 cycles or continuous

Segment looping:

1 to 4,096

Waveform hopping:

Programmed in memory or randomly using register access via VXI Data Transfer Bus (P1), VXI Local Bus (P2), or faceplate connector
FSK, PM

Modulation:

(Agilent E1445A continued)

Frequency Rates

Sample rate:	40 MSa/s
Time base sources:	Internal 40 MHz and 42.9 MHz crystals (50 ppm); VXI CLK10 line; VXI ECLTrig lines; faceplate BNC
Maximum waveform frequency:	10.7 MHz sine, 5 MHz square, 100 kHz ramp/triangle using 100 samples per cycle
Sweep:	Linear and log frequency
Frequency sweep range:	0.01 Hz to 10 MHz
Frequency hop range:	0.01 Hz to 10 MHz
Frequency hop rate:	Up to 500 kHz using registers, 800 Hz using SCPI
Frequency shift (FSK) rate:	Up to 2 M changes/s
Phase modulation rate:	Up to 500 kHz
Phase modulation source:	Software, VXI Local Bus (P2), or faceplate connector
Square waveform rise time:	17 ns typical

Output

Amplitude:	± 10.2 V max. (open circuit)
Output impedance (software selectable):	50 or 75 Ω (output also calibrated for open circuit)
Voltage amplitude range:	± 5.1 V in 1.25 mV steps in 50 Ω, ± 10.2 V in 2.5 mV steps in to high impedance.
Monotonicity:	>11 bits
Differential nonlinearity (dc):	4 LSB
Amplitude accuracy (dc):	± (0.3% + 5 mV) into 50 Ω
Output:	
Maximum offset:	± 5 V into 50 Ω
Maximum output:	± 5.5 V ac+dc into 50 Ω
Amplitude accuracy (ac):	± (0.1 dB + attenuator error + ac flatness) (Absolute)

Sine total harmonic distortion with internal filters applied:

Frequency Range	Harmonic Level
0.1 - 250 kHz	-60 dBc
0.25 - 4 MHz	-60 dBc + 20 log (f/250 k)
4 MHz - 10 MHz	-36 dBc

Note: f = output frequency

Sine spurious nonharmonic distortion:

Frequency Range	Non-harmonic Level
10 Hz - 1 MHz	-60 dBc or -60 dBm, (whichever is greater)
1 MHz - 4 MHz	-50 dBc
4 MHz - 10 MHz	-45 dBc

ac flatness:

Frequency Range	Flatness
0.1 Hz - 100 kHz	0.05 dB
100 - 250 kHz	0.1 dB
1 kHz - 10 MHz	0.2 dB

Note: relative to 1 kHz with internal filters

Attenuator range:	0 to 30 dB in 0.01 steps
Attenuator error:	0 dB at max output level, 0.05 dB at other levels
Output filters (software selectable):	250 kHz, 5-pole Bessel; 10 MHz, 7-pole Bessel; no filter applied

Auxiliary Input/Output

VXI Local Bus:	Data to DAC (not synchronized to time base and limited to 7.4 MSa/s typical), data to segment memory, waveform selection, phase modulation
Trigger sources:	Auto, hold, software, VXI TTLTRG, VXI ECLTRG, or faceplate BNC

Faceplate Connectors

Ref/sample in BNC:	Frequency reference, sample clock
Start arm in BNC:	Start arm
Stop trig/FSK/gate in BNC:	Trigger clock gate, Trigger stop, FSK
Marker out:	Any point, start of sequence, sample clock, reference frequency, frequency/phase change

Digital port:

VXI TTLTRG lines:

VXI ECLTRG lines:

Data to DAC or segment memory, waveform selection, phase modulation
Sample clock, gate, sweep arm/trigger, FSK input
Sample clock, reference frequency, start arm, all marker outputs

General Specifications

VXI Characteristics

VXI device type:	Message based
Data transfer bus:	A16, A32, D8/16/32 slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	Local Bus A-row, Local Bus C-row, TTL Trigger Bus, ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I _{PM}	I _{DM}
+5 V:	3.5	0.2
+12 V:	0.1	0.1
-12 V:	0.13	0.06
+24 V:	0.22	0.17
-24 V:	0.34	0.17
-5.2 V:	2.5	0.12
-2 V:	1.2	0.2

Cooling/Slot

Watts/slot:	44.00
ΔP mm H₂O:	0.50
Air Flow liter/s:	3.50

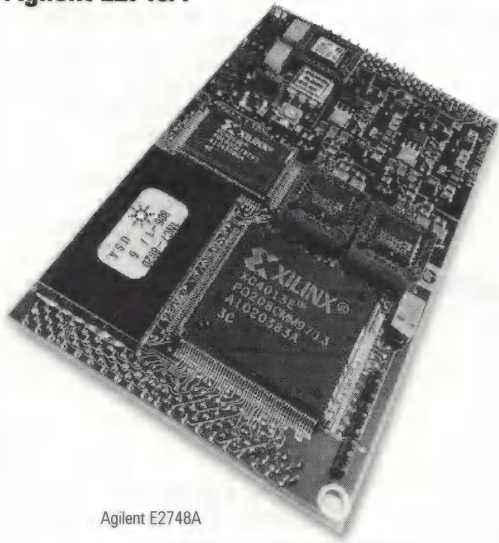
Ordering Information

Description	Product No.
C-Size Arbitrary Function Generator	E1445A
Service Manual	E1445A 0B3
Germany - German Localization	E1445A ABD
France - French Localization	E1445A ABF
Japan - Japanese Localization	E1445A ABJ
3 yr retn. to Agilent to 1 yr. OnSite warr.	E1445A W01
Backplane Connector Shield Kit	E1400-80920

Publication No.: 5965-5542E

Vector Waveform Generator Module, dc to 6 MHz

Agilent E2748A



Agilent E2748A

- 1-Slot, C-size, register based (1 - 6 Agilent E2748A modules per slot)
- Digital transmitter architecture platform for new or unique modulation formats
- Generate messages, including protocol
- Real-time signal generation from data
- Simulate real spectral environments with multiple channels
- Modulated IF and baseband I/Q outputs

Description

This Agilent Technologies E2748A TIM-40 Compatible Vector Waveform Generator module is optimized for generating digitally modulated signals for communications applications, covering a frequency range of dc to 6 MHz. Output is in the form of a baseband I/Q signal pair or a modulated IF. A quantity of one to six TIM-40 modules can be carried on a CI-sized Agilent SCM VX008 DSP module.

Modules act as independent signal generators and can produce QAM, PSK, QPSK, OQPSK, DQPSK, FSK, MSK, AM/FM/PM, etc. Each module contains 128 kSamples of memory and built-in programmable TDMA framing/bursting, coding, filtering and triggering. This enables each module to accept payload data asynchronously and perform all operations to produce a complete message with "live" data. The modular structure of the product lends itself to the generation of multiple simultaneous signals of different or similar characteristics, producing a realistic signal environment for receiver testing.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Solutions for RF Modulated Signals

The E2748A generates baseband I/Q signal pairs and a modulated IF with a carrier frequency of dc to 6 MHz. Upconversion of a single channel can be performed by connecting the I/Q outputs to an RF signal generator (such as the Agilent ESG-D series) with I/Q modulation input. Upconversion of a single channel or multiple channels can be performed with the 89431A Option AY8 over the frequency range of 2 MHz to 2.65 GHz. The software for the E2748A is specially designed for compatibility with the 89431A and can control the upconverter via the controller's RS-232 port.

For More Information

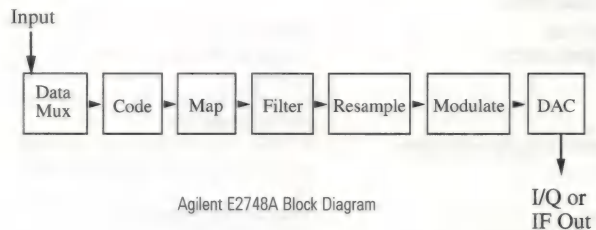
E2747/48A Vector Waveform Generator Product Overview, pub. no. 5968-1447E

E2747/48A Baseband Vector Waveform Generator Technical Specifications, pub. no. 5968-1047E

E2747/48A Vector Waveform Generator Configuration Guide, pub. no. 5968-1446E

SCMVX008 TI based VXI DSP Module Distributed Product Technical Specifications, pub. no. 5966-3437E

SCMVX008 TI based VXI DSP Module Distributed Product, Product Overview, pub. no. 5966-3438E



Agilent E2748A Block Diagram

Virtual Transmitter for Rapid Prototyping

The E2748A uses a generalized digital transmitter architecture. Unlike traditional arbitrary waveform generators, which can only play back pre-computed samples stored in memory, the vector waveform generator can also accept data as input, then apply the required coding, filtering, mapping and modulation, just as a digital transmitter does. This allows real-time signal generation from data.

The user has complete control over all the parameters of each block of the architecture, such as modulation type, symbol rate, number of symbol bits, etc. There are two means of accessing these: via a 'soft front panel' user interface which provides fill-in-the-blanks simplicity of operation, and via a function library interface for programmatic control. Both user interfaces run in a Windows NT/95 environment on a PC controller.

Real-World Signals for Real-World Testing

With complete control of message formatting, the user can generate signals which contain protocol fields and payload. Messages have 16 fields, each of variable length. The vector waveform generator can be directed to fill each field with data from one of several sources, including a data register for fixed data, a RAM file or a COM port for real-time message creation. The onboard random noise generator can also be used as a data source.

Simulate Multi-Signal Environments

A multi-channel system can be used to generate even more complete and realistic test signals. With independent control of each channel's frequency, modulation format, symbol rate and more, a vector waveform generator system can simulate realistic spectral environments including impairments, interferers and noise. Signal parameters can be varied independently and without reloading message data.

VXI and PC Format

The same vector waveform generator modules can be installed in VXI or PC carriers. The PC-based Agilent E2747A system allows a maximum of three channels. More channels are possible with the VXI-based carrier (the SCM VX008 with Options 001 and 002). Each VXI carrier accepts six E2748A modules, and you can use multiple carriers per VXI mainframe.

User Interface

Operating system:

Compatible with Windows NT or Windows 95. Operating system not included.

Soft front panel:

Graphical "fill in the blanks" template.

Function library:

Accessible via Microsoft Visual Basic or Microsoft Visual C++. Visual Basic and Visual C++ are not included.

Product Specifications

Frequency

Carrier frequency: dc to 6 MHz

Signal bandwidth:

Playback mode: 6 MHz

Real-time mode: 2 MHz typ.

(Actual bandwidth limit for real-time signal computation depends on filter and coding parameters selected by the user)

Clock accuracy: ± 30 PPM

(Measured at 15 MHz, 0-40° C, without phase lock. Clock is lockable to external 10 MHz frequency reference.)

(Agilent E2748A continued)**Amplitude**

Output Imp.:	50 Ω nominal
Level accuracy:	± 0.5 dB at 10 kHz
Flatness (rel to 10 kHz):	± 0.75 dB
Full scale output:	± 1 V into 50 Ω
dc offset:	± 50 mV

Dynamic Range

Spurious dist. (below full scale):	-70 dB
DAC resolution:	14 bits
Phase noise:	
$\Delta f=50$ Hz:	-80 dBc/Hz
$\Delta f=10$ kHz:	-130 dBc/Hz

(Frequency reference unlocked, output signal single sideband power density of 5 MHz signal)

General Specifications**VXI Characteristics**

VXI device type:	Register based
Data transfer bus:	A16/A32 - D64/D32/D16/D08
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	4, 8, 32, 64 MB
VXI buses:	Local Bus A-row (left), Local Bus C-row (right), TTL Trigger Bus, ECL Trigger Bus

Cooling/Slot

(Add for each E2748A installed in an SCM VX008)

Watts/slot:	8
ΔP mm H ₂ O:	0.093
Air flow liter/s:	0.67

Module Current

(Add for each E2748A installed in an SCM VX008)

	I_{PM} (A)	I_{DM} (A)
+5 V:	1.0	0.01
+12 V:	0.15	0.005
-12 V:	0.1	0.005
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

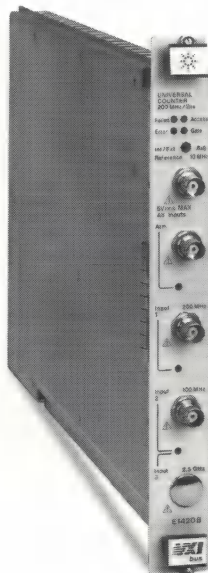
Ordering Information

Description	Product No.
Vector Waveform Generator Module, dc to 6 MHz	E2748A
Delete Manual Set	E2748A 0B0
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E2748A W01

Publication No.: 5968-1047E

Overview

Agilent E1420B



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B-Size Modules

Product No.	Description
E1332A	4-Channel Counter/Totalizer
E1333A	3-Channel Universal Counter

C-Size Modules

Product No.	Description
E1420B	High-Performance VXI Universal Counter

Introduction

With VXIbus counters from Agilent Technologies, you can rely on the same exceptional performance that you have always had from Agilent's high-performance benchtop and rack-mount universal counters. These products are optimized for automated test applications. A simpler hardware design means higher reliability and easier serviceability. The VXIbus interface allows system flexibility and high-speed throughput.

Overview: Counter Choices

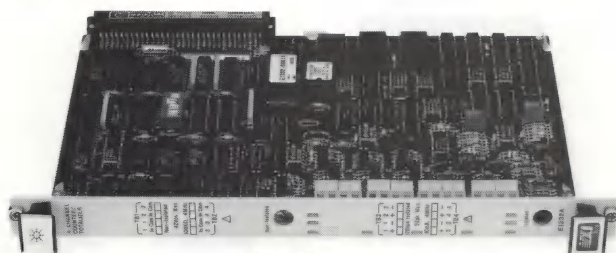
Agilent Technologies provides a selection of counters to address the need of making very rapid measurements in real time. These counters provide the capabilities needed for electronic test applications involving time and frequency.

Agilent offers a counter/totalizer module (E1332A), a 3-channel universal counter (E1333A), and a high-performance universal counter (E1420B). These modules feature high resolution, digital trigger control, and common clocks while providing higher stability, faster speeds, and sophisticated processing. Additionally, both the E1333A and E1420B modules include the full set of traditional universal counter measurements — frequency, period, time interval, totalize, and ratio. In particular, the E1420B is ideal for today's ATE applications requiring high speed in all phases of a measurement — setup, measure, and output.

All of Agilent's counter modules support the SCPI language. SCPI allows you to develop code that can easily be leveraged, increase the life of your test software, and decrease the time spent learning new instrument languages.

4-Channel Counter/Totalizer

Agilent E1332A



Agilent E1332A

- 1-Slot, B-size, register based
- Frequency range 4 MHz
- Seven counter functions
- Programmable direct or isolated inputs
- Programmable digital input filter and trigger levels
- Two input voltage ranges

Description

The Agilent Technologies E1332A 4-Channel Counter/Totalizer is a **B-size, 1-slot, register-based VXI device**. It provides seven counter functions: frequency (up to 4 MHz), period average, pulse width, time interval, totalize, gated totalize, and up/down count.

With this module, you select either isolated or direct inputs through software commands. You can connect a total of eight channels to one counter card (only four can totalize simultaneously) by multiplexing between four isolated channels and four non-isolated channels. The digital input low-pass filter is also software selectable with Pass Frequency in 16 binary steps from 4 Hz to 131 kHz. It filters out the high-frequency noise of input signals, such as the bounce of mechanical switches.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Frequency Measurement

Channels 1 and 3 measure frequency up to 4 MHz (2 and 4 not available). You can select the resolution directly in Hz or the gate time from 2 ms to 65.5 s in 16 binary steps.

- Minimum pulse width: 125 ns
- Resolution: 1/gate time

Period Average Measurement

Channels 1 and 3 (2 and 4 not available) average 2^N periods of an input signal. Select the resolution directly in seconds or the number of periods to be averaged.

- Minimum pulse width: 125 ns
- Range of N: 1 to 16
- Resolution: $1 / (5 \times 10^6 \times 2^N) \text{ s}$

Pulse Width Measurement

Channels 2 and 4 (1 and 3 not available) measure pulse width (positive or negative) of an input signal.

- Minimum pulse width: 500 ns
- Maximum pulse width: 858 s
- Resolution: 200 ns

Time Interval Measurement

You can measure the time interval between transitions from channel 1 to channel 2 or from channel 3 to channel 4. You select the rising or falling edge via software commands.

- Minimum interval: 500 ns
- Maximum interval: 858 s
- Resolution: 200 ns

Totalizing

You can count the number of transitions (rising or falling edge) on channels 1, 2, 3 and 4.

- Minimum pulse width: 125 ns
- Range: 1 to $(2^{32}-1)$ Counts

Gated Totalizing

You count the number of transitions (rising or falling edges) on channels 1 and 3. Channel 2 is used as a gate for channel 1. Channel 4 is used for channel 3. The polarity of the gate is programmable.

- Minimum pulse width: 125 ns
- Range: 1 to $(2^{16}-1)$ Counts

Up/Down Counting

Channels 1-2 and channels 3-4 form the up/down pairs. The count on channel 2 (4) is subtracted from that on channel 1 (3), and the result is given.

- Minimum pulse width: 125 ns
- Range: $\pm (2^{31}-1)$

Input Signal Conditioning commands control all channels simultaneously. Trigger level/sensitivity commands are available for each channel.

C-size adapter

This product is easily adapted for use in a C-size mainframe. See the Accessories section for a selection of adapters.

Product Specifications

Functions

Period:	Yes
Time interval:	Yes
Totalizer:	Yes
Gated totalizer:	Yes
Ratio:	No
Pulse width:	Yes
Rise/fall time:	No
Phase:	No
Vdc:	No
Vac:	No
Up/down counter:	Yes
Number of channels:	4
Frequency:	4 MHz to 0.002 Hz (input filter is OFF)

Pass Frequency of Input Digital Filter

4 Hz to 131 kHz in 16 binary steps

Time Base

Frequency:	10 MHz
Initial accuracy:	2 ppm
Aging:	2 ppm/year
Temperature drift:	5 ppm (0 to 50° C)

Nonisolated Input

Input Impedance:	(typical) 100 k Ω shunted by 80 pF
------------------	--

Input Ranges

(jumper selectable)	
Low range:	$\pm 5 \text{ V}$
High range:	$\pm 42 \text{ V}$

Trigger Level

Low input range:	-2.56 to 2.54 V in 20 mV step
High input range:	-25.6 to 25.4 V in 0.2 V step

Sensitivity

Low input range:	
dc to 2 MHz:	25 mV
2 MHz to 4 MHz:	50 mV
High input range:	
dc to 100 kHz:	250 mV
100 kHz to 1 MHz:	500 mV
1 MHz to 2.5 MHz:	1 V
2.5 MHz to 3.5 MHz:	2 V

Frequency Dynamic Range

Low input range:	
dc to 2 MHz:	43 dB
2 MHz to 4 MHz:	37 dB
High input range:	
dc to 100 kHz:	35 dB
100 kHz to 1 MHz:	29 dB
1 MHz to 2.5 MHz:	23 dB
2.5 MHz to 3.5 MHz:	17 dB

(Agilent E1332A continued)

Isolated Input

V_{in} (High):	>4.2 V
V_{in} (Low):	<1 V
I_{in} (High):	>6.3 mA
I_{in} (Low):	<250 μ A
Isolation:	170 Vp (Channel-to-channel, channel-to-chassis)

Maximum Screw Terminal Wire Size

16 AWG (1.5 mm)

General Specifications

VXI Characteristics

VXI device type:	Register based
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	n/a
VXI buses:	n/a
C-size compatibility:	Yes (with E1403C Adapter)

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	ROM
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.5	0.01
+12 V:	0.03	0.01
-12 V:	0.02	0.01
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	3.00
ΔP mm H ₂ O:	0.05
Air Flow liter/s:	0.25

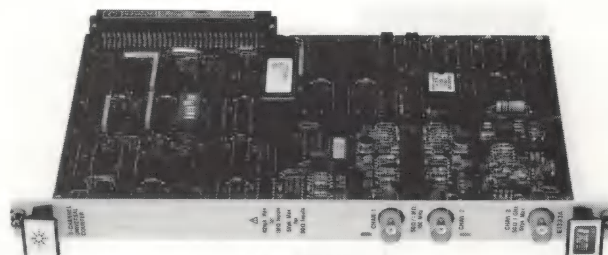
Ordering Information

Description	Product No.
4-Channel Counter/Totalizer	E1332A
Service Manual	E1332A 0B3
Mil Std 45662A Calibration w/Test Data	E1332A 1BP
Japan - Japanese Localization	E1332A ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite warr.	E1332A W01

Publication No.: 5965-5546E

3-Channel Universal Counter

Agilent E1333A



Agilent E1333A

- 1-Slot, B-size, register based
- Six counter functions
- 1 GHz frequency measurement
- 1 ns time interval/pulse width resolution (avg mode)
- Compatible with all Agilent Foundations
- Measure time interval between transitions

Description

The Agilent Technologies E1333A 3-Channel Universal Counter is a **B-size, 1-slot, register-based VXI module**. It provides the capabilities needed for electronic test applications. You can connect three signals to one counter card and multiplex between them to measure frequency. Counter functions include frequency, period average, pulse width and pulse width average, time interval and time interval average, totalize, and ratio.

You can select the resolution directly in seconds, the number of periods to be averaged, the number of intervals (2^n to be averaged), or the number of transitions (2^n on one channel). Additionally, you can measure the time interval between transitions from one channel to another channel, or measure the frequency ratio between channels 1 and 2 or channels 2 and 1.

To complete the E1333A module's functionality, you may also select the rising or falling edge via software commands, and count the number of transitions on channels 1 and 2. Input Signal Conditioning commands control all channels simultaneously. Trigger level/sensitivity commands are available for each channel.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Frequency Measurement

- Minimum pulse width (Channels 1 and 2): 5 ns
- Resolution: 1/gate time

Period Average Measurement

Channels 1 or 2 average 2^N periods of an input signal. You select the resolution directly in seconds or the number of periods to be averaged.

- Minimum pulse width: 60 ns
- Range of N: 1 to 16
- Resolution: $1 / (10 \times 10^6 \times 2^N)$ s

Pulse Width (with Average Mode) Measurement

- Minimum pulse width: 200 ns
- Maximum pulse width: $(6871/2^N)$ s
- Range of N: 0 to 7
- Resolution: $(100/2^N)$ ns

Time Interval (with Average Mode) Measurement

You can measure the time interval between transitions from one channel to another channel. You select the resolution directly in seconds or the number of intervals, 2^N to be averaged. You select the rising or falling edge via software commands.

- Minimum interval: 200 ns
- Maximum interval: $(6871/2^N)$ s
- Range of N: 0 to 7
- Resolution: $(100/2^N)$ ns

(Agilent E1333A continued)

Totalizing

- Minimum pulse width: 5 ns
- Range: 1 to ($2^{26}-1$)

You can count the number of transitions on channels 1 and 2.

Frequency Ratio Measurement

You can measure the frequency ratio between channels 1 and 2 or channels 2 and 1. You select the resolution directly or the number of transitions, 2^N on one channel.

- Minimum pulse width: 5 ns
- Range of N: 6 to 36
- Resolution: $\frac{1}{2}^N$

Input Signal Conditioning commands control all channels simultaneously.

Trigger level/sensitivity commands are available for each channel.

C-size Adapter

This product is easily adapted for use in a C-size mainframe. See the Accessories section for a selection of adapters.

Product Specifications**Functions**

Period:	Yes
Time interval:	Yes
Totalizer:	Yes
Gated totalizer:	No
Ratio:	Yes
Pulse width:	Yes
Rise/fall time:	No
Phase:	No
Vdc:	No
Vac:	No
Up/down counter:	No
Number of channels:	3

Time Base

Frequency:	10 MHz
Initial accuracy:	2 ppm
Aging rate:	2 ppm/year
Temperature drift:	5 ppm (0 to 50° C)

**Channels 1 and 2
Channel 3**

Frequency range:	75 MHz to 1 GHz, prescaled by 64
Coupling:	ac coupled
Input impedance:	50 Ω
Input range:	± 5 Vp
Sensitivity:	
75 MHz to 600 MHz:	10 mV
600 MHz to 900 MHz:	30 mV
900 MHz to 1 GHz:	40 mV
Dynamic range:	
75 MHz to 600 MHz:	51 dB
600 MHz to 900 MHz:	41 dB
900 MHz to 1 GHz:	39 B
VSWR (typical):	1.5 @ 0 dBm

Dynamic Range

Low input range (dc to 100 MHz):	43 dB
High input range (dc to 100 MHz):	41 dB

Sensitivity

Low input range (dc to 100 MHz):	25 mV
High input range (dc to 100 MHz):	250 mV
Input range: (select the input attenuator)	
Low range:	± 5 V
High range:	± 42 V
Trigger level:	
Low input range:	-2.56 V to 2.54 V in 20 mV step
High input range:	-25.6 V to 25.4 V in 0.2 V step
Input attenuator:	Programmable x1 or x10 attenuator
Filter:	Programmable Low-Pass Filter, 3 dB point at 100 kHz
Input impedance (typical):	Programmable 1 M Ω shunted by 50 pF or 50 Ω
Coupling:	Programmable ac or dc coupled
Frequency range:	
ac coupled:	100 Hz to 100 MHz
dc coupled:	dc to 100 MHz

General Specifications**VXI Characteristics**

VXI device type:	Register based
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	n/a
VXI buses:	n/a

Instrument Drivers -See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	ROM
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.5	0.01
+12 V:	0.03	0.01
-12 V:	0.02	0.01
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	5.00
ΔP mm H ₂ O:	0.08
Air Flow liter/s:	0.42

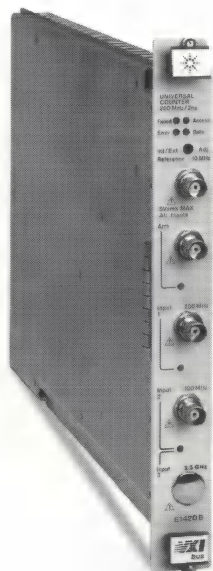
Ordering Information

Description	Product No.
3-Channel Universal Counter	E1333A
Service Manual	E1333A 0B3
Japan - Japanese Localization	E1333A ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1333A W01

Publication No.: 5965-5547E

High-Performance VXI Universal Counter

Agilent E1420B



Agilent E1420B

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- 1-Slot, C-size, message based
- 200 MHz frequency range, optional 2.5 GHz channel
- 9-digit resolution in 1 second gate time
- 2 ns time interval resolution (200 ps with averaging)
- Shared memory option configuration
- Phase measurement and measurement timeout

Description

The Agilent Technologies E1420B High-Performance Universal Counter is a C-size, 1-slot, message-based VXI module. It provides the full set of traditional universal counter measurements (frequency, period, time interval, totalize, and ratio), plus the automatic measurements of rise/fall time, pulse width, phase, and ac/dc voltages. Additionally, this module provides x10 attenuation, allowing measurements of higher-powered signals.

The E1420B is ideal for today's ATE applications requiring high speed in all phases of a measurement – setup, measure, and output. It can make up to 60 measurements per second of the same function. It can also sequence through a series of different functions at up to 40 measurements per second. For even faster measurements, the optional shared memory capability yields up to 160 measurements per second. This shared RAM option allows the E1420B to send measurement data to a VXI device with shared RAM. Data may be accessed by the controller, thus eliminating data formatting time and providing higher measurement throughput.

The E1420B features the industry standard SCPI interface language. SCPI will let you develop code that can easily be leveraged, increase the life of test software, and decrease the time spent learning new instrument languages.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Outstanding Resolution and Range

The E1420B offers a 200 MHz frequency range (2.5 GHz with option 030) and 2 ns time interval resolution (200 ps with averaging). Rise and fall times can be measured automatically down to 15 ns.

Improve the System Clock Without Sacrificing Mainframe Space

An optional highly stable TCXO time-base is available for the E1420B. By externally driving the VXI system clock (CLK10) with this TCXO, you can substantially reduce system clock errors without losing valuable mainframe slots. This option improves measurement repeatability and accuracy.

Measurement Timing Control

For synchronizing your measurement to an external event, such as an RF burst, VXIbus and external triggering are available.

Programmable measurement time-outs help you optimize system performance even if the input signal is absent.

Single Measurement Auto-Trigger Speeds Measurements

Repetitive auto-trigger measurements are faster than ever with the E1420B's single measurement auto-trigger. This feature analyzes the input signal only once, setting the trigger levels, and speeding through the rest of the measurements.

Adjustable Sensitivity

Measuring low-level signals isn't a problem: the Agilent E1420B features 35 mV rms sensitivity to 200 MHz. When noise is a problem, this sensitivity can be decreased to 100 mV rms by using hysteresis control.

Optional 2.5 GHz Channel (Input 3)

Increase your frequency range to 2.5 GHz for communications and navigation applications.

Save on Software Costs with SCPI

The E1420B features the industry standard SCPI interface language. SCPI will let you develop code that can easily be leveraged, increase the life of test software, and decrease the time spent learning new instrument languages. SCPI also simplifies the use of the counter; for example, you can set a trigger level using a percentage of signal amplitude.

Product Specifications

Functions

Period:	Yes
Time interval:	Yes
Totalize:	Yes
Gated totalize:	Yes
Ratio:	Yes
Pulse width:	Yes
Rise/fall time:	Yes
Phase:	Yes
Vdc:	Yes
Vac:	Yes
Up/down counter:	No

(Agilent E1420B continued)

Measurements

Frequency:	200 MHz (standard) 2.5 GHz (with option)
Frequency 1, 2, 3:	
Range:	0.001 Hz to 200 MHz, input 1; 0.001 Hz to 100 MHz, input 2; 90 MHz to 2.5 GHz, input 3 (Optional)
Resolution:	9 digits/s of measurement time + trigger error + system jitter (Frequency resolution is directly proportional to gate time. For example, resolution is 9 digits for a 1-second gate time and 8 digits for a 0.1-second gate time.)
Period 1, 2, 3:	
Range:	5 ns to 1,000 s, input 1; 10 ns to 1000 s, input 2; 400 ps to 10 ns, input 3 (Optional)
Resolution:	Same as Frequency
Time interval (TI) 1 to 2:	
Range:	1 ns to 1,000 s (single-shot); 1 ns to 10 s (averaging) (100-gate average)
Resolution:	2 ns + trigger error, single-shot; 200 ps + trigger error, averaging
Rise/fall time 1:*	
Range:	15 ns to 400 μ sec (automatic); to 800 sec (manual)
Resolution:	Same as TI
Pulse width 1, 2:*	
Range:	5 ns to 1 ms
Resolution:	Same as TI
Phase 1 relative 2:*	
Range:	0.1° to 360°
Resolution:	TI resolution x frequency x 360°
Ratio 1/2, 2/1, 3/1:	
Range (1/2, 2/1):	0.001 Hz to 100 MHz
Range (3/1):	90 MHz to 2.5 GHz (Optional)
Totalize 1, 1 by 2, 2 by 1:	
Range:	0 to (1 x 1.0E12 - 1) events
Min/max, ac voltage 1, 2:*	
Range:	200 mVp-p to 10 Vp-p (x Atten.)
Resolution:	30 mV (x Atten.)
Min/max, dc voltage 1:	
Range:	30 mV to ± 10 V (x Atten.)
Resolution:	30 mV (x Atten.)

*Frequency range 1 kHz to 20 MHz.

Input Characteristics for Channels 1, 2

Sinewave sensitivity:	35 mV rms
Pulse sensitivity:	100 mVp-p (with minimum pulse width of 5 ns)
Dynamic range:	100 mVp-p to 10 Vp-p (x Atten.)
Attenuator:	x1 (default) or x10
Signal operating range:	± 10 V (x Atten.) (1 M Ω); ± 5 V (50 Ohm)
Trigger level range:	± 10.2 V with step size of 2.5 mV (Specified by V or % of signal)
Trigger level accuracy:	± 30 mV (x Atten.) $\pm 1\%$ of trigger level
Coupling:	ac/dc
Impedance:	50 Ω /1 M Ω (default programmable)
Slopes:	Positive or Negative
Input:	Separate or Common (1 routed to 2)

General Characteristics

Gate time:	1 ms to 99.99s in 1 ms steps
External arm:	via front-panel BNC or VXI TTL TRIG lines
Auto trigger:	
Range:	1 kHz to 20 MHz (Single or Repetitive Range)
Minimum amplitude:	200 mVp-p (x Attn.)
TI delay (inserts delay after start event before allowing stop event to occur):	
Range:	1 ms to 99.999 s in 1 ms step
Measurement timeout:	0.1 s to 1,500 s
Gate output:	VXI TTLTRIP Lines
Measurement throughput rate (measured using Radisys EPC-2):	
Free-run:	Up to 60 Measurements/s
Switching:	Up to 40 Measurements/s
Shared memory (option 040):	Up to 160 Measurements/s
Memory states:	10 setups can be stored and recalled (Volatile)

Time Base

Standard:	VXI CLK10
Option 010 TCXO time base:	
Frequency:	10 MHz
Aging:	<0.1 ppm/month
Temperature:	± 1 ppm, 0 to 40° C

UHF Channel (Input 3) (Option 030)

Frequency range:	90 MHz to 2.5 GHz
Sensitivity (sinewave):	
90 MHz-1 GHz:	-25 dBm
1 GHz-1.8 GHz:	-20 dBm
1.8 GHz-2.5 GHz:	-12 dBm

Shared Memory (Option 040)

Shared memory throughput rate:	Up to 160 Measurements/s
---------------------------------------	--------------------------

General Specifications**VXI Characteristics**

VXI device type:	Message based
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	Yes
VXI buses:	TTL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

(Agilent E1420B continued)

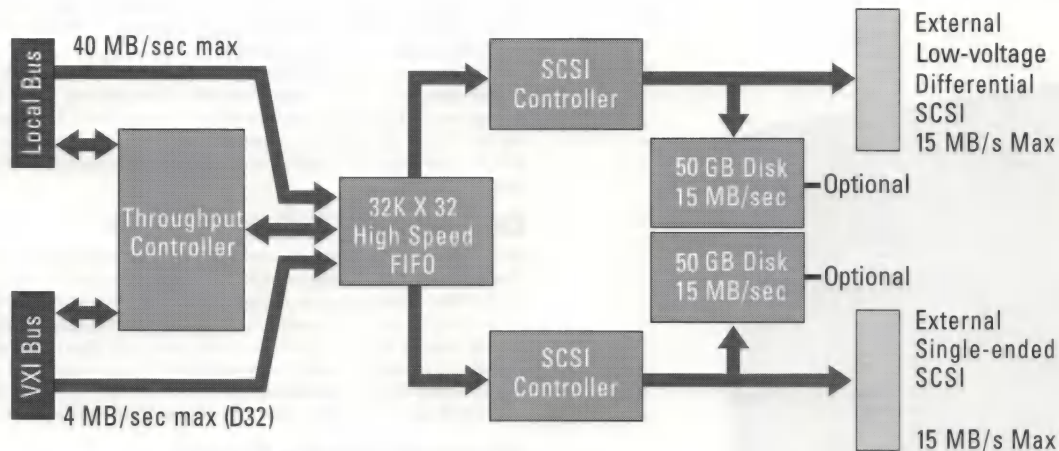
Module Current		
	I _{PM}	I _{DM}
+5 V:	2	0.15
+12 V:	0.25	0.01
-12 V:	0.15	0.02
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0.8	0.03
-2 V:	0	0

Cooling/Slot		
Watts/slot:	15.50	
ΔP mm H ₂ O:	0.15	
Air Flow liter/s:	1.00	

Ordering Information

Description	Product No.
High-Performance VXI Universal Counter	E1420B
TCXO Time Base	E1420B 010
UHF Input Channel	E1420B 030
High Throughput/Shared RAM	E1420B 040
Operation Manual	E1420B 0B2
Service Manual	E1420B 0B3
Refurbished Equipment	E1420B 8ZE
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1420B W01

Publication No.: 5965-5548E



C-Size Modules

Product No.	Description
N2216A	VXI/SCSI Interface Module
E3249B	18 Gbyte VXI System Disk
E9830A	Delay Memory Module

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Introduction

Agilent Technologies offers modules to help you identify and capture your data. Data storage modules help you extend the memory of your VXI instruments and help you make online recordings of your digital data. Agilent also provides a hard drive for your operating system and data storage to help you maintain transportability of your VXI system and to provide a backup mechanism in the industry-standard Digital Data Storage (DDS) format.

Overview: Data Storage and SCSI System Disk

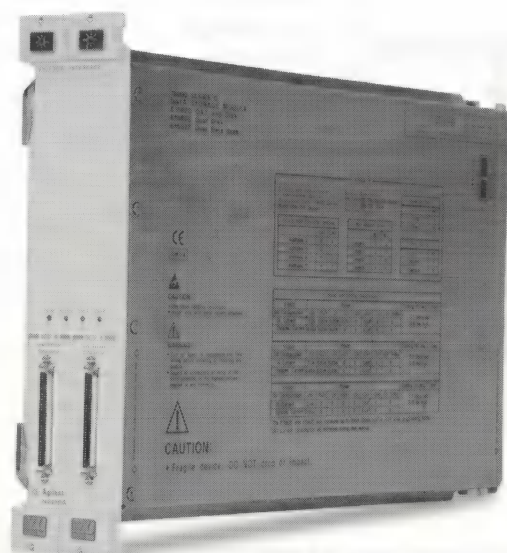
The Agilent N2216A VXI/SCSI Interface module is used for online recording of digital data and is ideal for a variety of static and transient data capture applications as a replacement for an analog data recorder. Random access to any data segment is rapidly available without time-consuming rewinding. The N2216A is used in transient signal analysis, acoustic and mechanical measurements, and electronic surveillance.

The Agilent E3249B SCSI-2 module with DAT drive provides you with a mass storage system when a larger system disk is required. It is also recommended when frequent data or system backup requires a built-in DAT drive. This module has an 18 Gbyte system disk and a 4 Gbyte DAT drive, eight Gbytes with data compression. The module links to the host computer without connecting through the VXI backplane. This means the controller communication with the disk will not interrupt or be interrupted by traffic on the VXI backplane. Additionally, with the E3249B module, you can connect to other SCSI-2 devices via the second SCSI-2 connector.

Whether your project requires a signals development system, signal analysis system or data acquisition system, success depends upon capturing the right information as quickly as possible. The Agilent E9830A Delay Memory module records data representing wide bandwidth energy for post-processing and analysis. It also has delay mode capability, which lets you see signals from the beginning, ensuring first-bit or first-syllable copy of energy of interest.

VXI/SCSI Interface

Agilent N2216A



Agilent N2216A

- 2-Slot, C-size, message based
- Online recording of digital data
- Fast, continuous data throughput to disk
- Low-voltage differential SCSI interface
- Optional internal 50 GB or dual 50 GB drives
- 30 MB/sec data transfer rate to internal dual drives

Description

The Agilent Technologies N2216A VXI/SCSI Interface is a C-size, 2-slot, message-based VXI module used for online recording of digital data. It is ideal for a variety of static and transient data capture applications as a replacement for an analog data recorder. Random access to any data segment is rapidly available without time-consuming rewinding. The N2216A is used in transient signal analysis, acoustic and mechanical measurements, and electronic surveillance. Using the VXI Local Bus, you can transfer data from VXI A/D modules at a maximum sustained rate of 30 MB per second to the optional dual internal hard drives.

The standard N2216A has dual low-voltage differential SCSI interfaces that can be connected directly to external hard drives or DAT tape drives. There are options available to add one or two 50 GB internal hard drives for local data storage capacity. The N2216A can be used as a replacement or upgrade for the Agilent E1562 (excluding internal DAT drive and high-voltage SCSI interface to external devices).

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Sustained Data Throughput to Optional Dual Internal Disks at 30 MB/s

You don't need to accept gaps or missing samples in your high-speed transient digital data capture applications. Using the VXI Local Bus, you can transfer data from VXI A/D modules to the optional dual disk version of the N2216A at a real-time, maximum sustained rate of 30 MB per second without losing a single byte of data. With 100 GB of disk storage, you can write data to the disk at a 30 MB-per-second maximum rate for 55 minutes.

In cases where you also need to monitor the Local Bus data as it is being written to disk, some (or all) of the data can be transferred to the VXIbus for monitoring by the host computer. If the amount of data sent to the host is small compared to the total, the overall throughput rate will not be significantly affected.

You can also transfer data from A/D modules via the Local Bus to external SCSI devices at 15 MB per second on each of the two SCSI interfaces. That's 30 MB per second sustained!

If you use VXI input modules without Local Bus support, you can transfer data to the SCSI module over the VXI backplane. These transfers can take place at a maximum rate of 4 MB per second (D32). For example, nine Agilent E1413C 64-channel modules can be simultaneously writing data to the N2216A providing 576 channels scanned every 640 microseconds without losing any samples.

Comprehensive Software Support

The N2216A is a message-based module with VXIplug&play drivers for Windows 98/NT. It contains a SCPI interpreter compatible with the Agilent E1562. This allows software packages such as Agilent VEE an easy way to set up the N2216A data disk module. Programming with Agilent VEE, you can use the existing E1562 VEE driver or use direct I/O. This provides a relatively simple and straightforward programming interface via the SCPI command set. The complexity of managing data flow from multiple VXI A/D modules to multiple disks is reduced to typically a dozen SCPI commands.

Additional Software Support

Use the N2216A with simple SCPI commands with a VXI embedded controller (such as the Agilent E9851A), an external PC controller, or an HP Series 700 Computer connected via MXI interface. The SCPI command set is also identical to the Agilent E1562D/E (excluding the DAT drive) so the N2216A can be used as a replacement or upgrade to larger internal hard drive storage.

Replace Analog Tape Recorders in Many Applications

You may be able to replace your analog or digital tape recorder when you add a N2216A module to your system. Writing digitized data to disk provides more dynamic range than is available on analog tape recorders. Recording data on the N2216A disk module gives you rapid, random access to any segment of the data—no more rewinding.

Working with VXI Digitizers and Signal Processors

Any VXI module that produces VXI Local Bus data will work with the N2216A. VXI modules in this category include high-performance devices such as Agilent's E1432A 16-Channel, 51.2 kSa/sec Digitizer with DSP, E1433B 8-Channel 196 kSa/sec Digitizer plus DSP, and E1437A Digitizer with DSP, as well as combinations of these devices and the Agilent E1485C Digital Signal Processor. Modules that send data through a VMEbus can also take advantage of the N2216A.

Product Specifications

Performance

SCSI interface:	Dual low-voltage differential
Transfer rate:	15 MB/sec max to external device
Opt 001 internal 50 GB hard drive:	VXI bus to disk
Transfer rate:	15 MB/sec max
Opt 002 internal dual 50 GB hard drives:	
Transfer rate:	30 MB/sec max

General Specifications

VXI Characteristics

VXI device type:	Message based
Data transfer bus:	n/a
Size:	C
Slots:	2
Connectors:	P1/P2
Shared memory:	Yes
VXI buses:	Local Bus A
	Local Bus C
	TTL Trigger Bus

(Agilent N2216A continued)

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	Yes (use E1562 driver)
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	Yes (10.x only)

Cooling/Slot

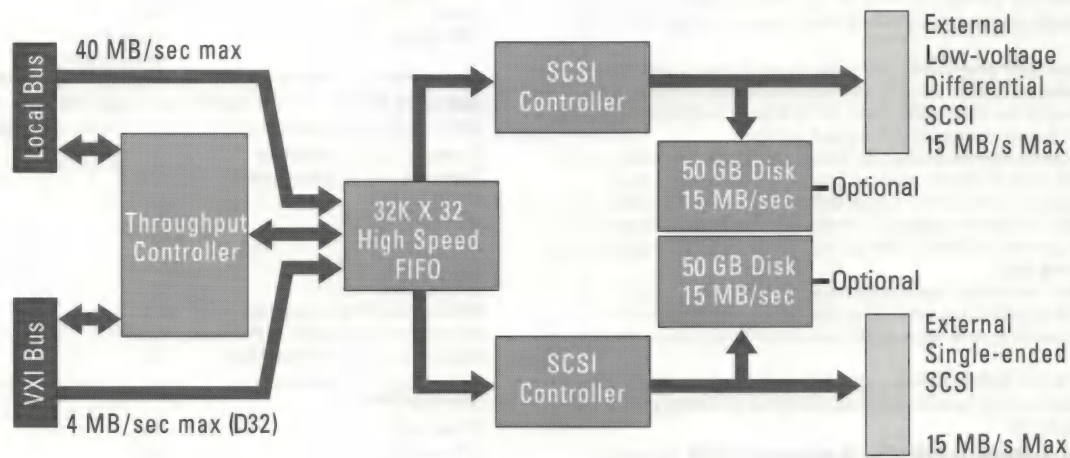
Watts/slot:	24.0
ΔP mm H₂O:	0.13
Air Flow liter/s:	3.30

Module Current

	I_{PM}	I_{DM}
+5 V:	3.0	0.65
+12 V:	0	0
-12 V:	0	0
+24 V:	0.6	0.4
-24 V:	0	0
-5.2 V	0.6	0.03
-2 V:	0.05	0.01

Ordering Information

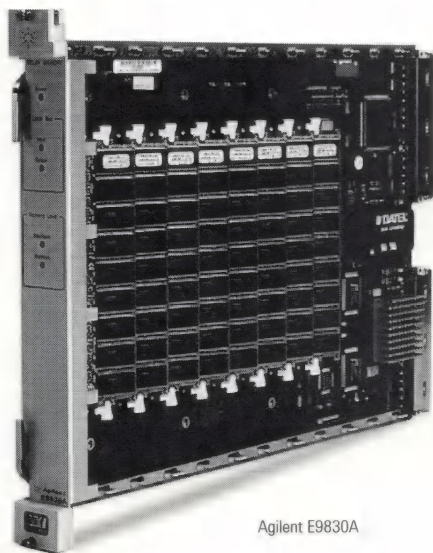
Description	Product No.
VXI/SCSI Interface	N2216A
Add Internal 50 GB Hard Drive	N2216A 001
Add Internal Dual 50 GB Hard Drives	N2216A 002
Delete Manual Set	N2216A 0B0
Add Manual Set	N2216A 0B1
3 yr. Retn. To Agilent to 1 yr. OnSite Warr.	N2216A W01



Publication No.: 5980-1498E

Delay Memory Module

Agilent E9830A



Agilent E9830A

12

- Eight SDRAM DIMM sockets allow 128 to 2048 MB of delay memory
- Simultaneous input and output data transfers at up to 53 MB/s (Agilent Local Bus)
- Delay mode allows delay time to be set in increments of 512 bytes
- Snapshot mode collects input data up to 2048 MB
- A16/D16 (D32 for data transfer only)
- Segmentable data output

Description

The Agilent Technologies E9830A Delay Memory Module is a C-size, 1-slot, register-based VXI module. Successful COMINT missions depend on the highest productivity from system creators, systems and operators. Enhance your productivity by adding the E9830A Delay Memory module to a COMINT system.

Whether your project requires a signals development system, direction finding system, or data analysis system, success depends upon finding and saving the right information the first time. The E9830A helps by providing two modes of operation: delay and snapshot.

Delay mode lets you see signals from the beginning, ensuring first-bit or first-syllable copy of energy of interest. In systems that perform signal monitoring, use the E9830A to give your DSP algorithms the time they need to detect signals of interest hidden in a digital data stream. Attain long delay times by configuring the E9830A with up to 2048 MB of memory connected to the Agilent Local Bus.

When a "rare event" signal appears, use snapshot mode to save the entire event for detailed post processing. Place multiple delay memory modules in adjacent slots to increase the amount of delay or snapshot time in the system.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

First-Bit Capture with the Agilent E3238 Signals Development System

Enhance your productivity by adding the E9830A Delay Memory module to your Agilent 3238 Signals Development System. The E3238 software integrates the module for you, providing an easy-to-use graphical user interface as well as automatic controls. Catch and hold elusive signals in delay memory while your DSP algorithms determine if they are of interest. If so, the system can send selected signals, including first-bit or first-syllable, to downstream processing for closer inspection, demodulation and logging.

Decrease time to analysis by adding the E9830A Delay Memory module to your E3238 Signals Development System. When an unknown signal of interest appears, take instant signal snapshots for post-capture analysis and demodulation. Take snapshots at the click of a mouse, or after user-defined signal alarm criteria are met.

Segmentable Memory Output

Stay efficient by transferring only the data that you need. The E9830A can send all or a select portion of the recorded data over the VXIbus or Agilent Local Bus. Program the memory pointers to select the data of interest to be sent from the module.

Use Either Agilent Local Bus or VXIbus Data Transfers

The E9830A can store and send data simultaneously, either over the VXIbus or over the fast Agilent Local Bus. Achieve up to 53 MBytes/s transfer speed over the Agilent Local Bus. Configure several Agilent instruments that use the Agilent Local Bus with the E9830A, including the Agilent E1430A and E1437A digitizers and the SCM VX008 and E1485C digital signal processors. If you use VXI input modules that do not have Agilent Local Bus support, data can be transferred to the E9830A over the VXIbus.

Comprehensive Software Support

The delay memory module is a register-based VXI module that is VXIplug&play compatible. It is supported by a set of C example programs for use in HP-UX or Microsoft Windows operating systems. The module's command set provides a simple, straightforward interface for programming the module.

For More Information

E9830A Delay Memory Module Product Overview, Pub No.: 5968-7349E.

Product Specifications

General

Memory size:	128 to 2048 MB
Memory type:	PC100 non-buffered ECC SDRAM DIMMs (100 MHz speed)
Data transfer speed:	VXI Local Bus (LBUS)-up to 53 MB/sec

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	D16, partial D32
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	No
VXI buses:	Local Bus A Local Bus C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	No
Command module firmware rev:	n/a
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

Watts/slot:	14
ΔP mm H ₂ O:	0.03
Air Flow liter/s:	1.2

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	2	1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0.7	0.07
-2 V:	0.175	0.02

(Agilent E9830A continued)

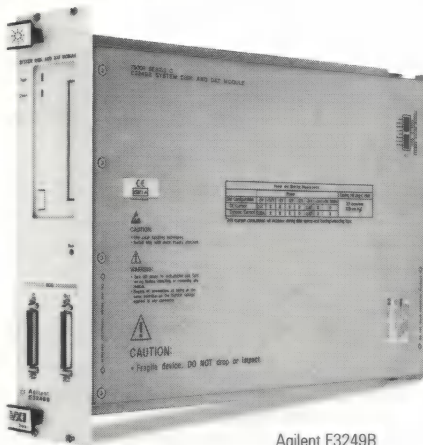
Ordering Information

Description	Product No.
Delay Memory Module	E9830A
Increase Memory to 1024 MB	E9830A 010
Increase Memory to 2048 MB	E9830A 020

Publication No.: 5968-7349E

18 Gbyte VXI System Disk with DAT Drive

Agilent E3249B



Agilent E3249B

- Ultra-SCSI or Fast-20 SCSI compatible system disk with DAT tape
- Compatible with SCSI-1 and SCSI-2
- 18 Gbyte hard disk
- 1,200,000-hour projected MTBF hard disk
- 4-Gbyte DAT tape (8 Gbyte typical w / compression)
- Packaged in 2-slot VXI module

Description

The Agilent Technologies E3249B is a C-size 2-slot VXI mass storage module. It consists of an 18 Gbyte system disk and a 4-Gbyte (8 Gbytes with data compression) DAT drive. This module is targeted as a system disk for an embedded host controller with a single-ended SCSI interface. The DAT drive offers a convenient mechanism for frequent system or data backups.

The Instant Ignition options install HP-UX 10.2 on the disk. These options require the Logical Volume Manager.

The single-ended SCSI-2 connectors on the front panel provide the link to the host computer via a short external cable. Connection to other SCSI-2 devices is achieved via the second SCSI-2 connector. The SCSI-2 interface does not provide a connection to the VXI backplane, assuring that the interface traffic will not interrupt, or be interrupted by traffic on the VXI backplane. Typically, backup of 2 Gbytes takes approximately 30 minutes with compression and the industry standard Digital Data Storage (DDS) format.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Hard Drive

Capacity:	18.37 GB
Average read:	6.0 ms
Average write:	6.5 ms
Track-to-track seek:	<1.0 ms
Head switch time:	<1 ms
Data transfer rate:	
Synchronous:	Up to 20 MB/s
Asynchronous:	Up to 6.0 MB/s

DAT Drive

Capacity (120 meter DDS-2 tape):	
Non-compressed:	4.0 GB
Compressed:	8.0 GB
Transfer rate:	
Sustained non-compressed:	510 KB/s
Sustained compressed:	1.0 MB/s
Burst asynchronous:	3.0 MB/s (Max)
Average search speed:	<40 s for any file on 120 meter tape

General Specifications

Module Current

	I_{PM}	I_{DM}
+5 V:	2.4	0.55
+12 V:	0	0
-12 V:	0	0
+24 V:	0.6	0.4
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	15.20
ΔP mm H ₂ O:	0.13
Air Flow liter/s:	3.30

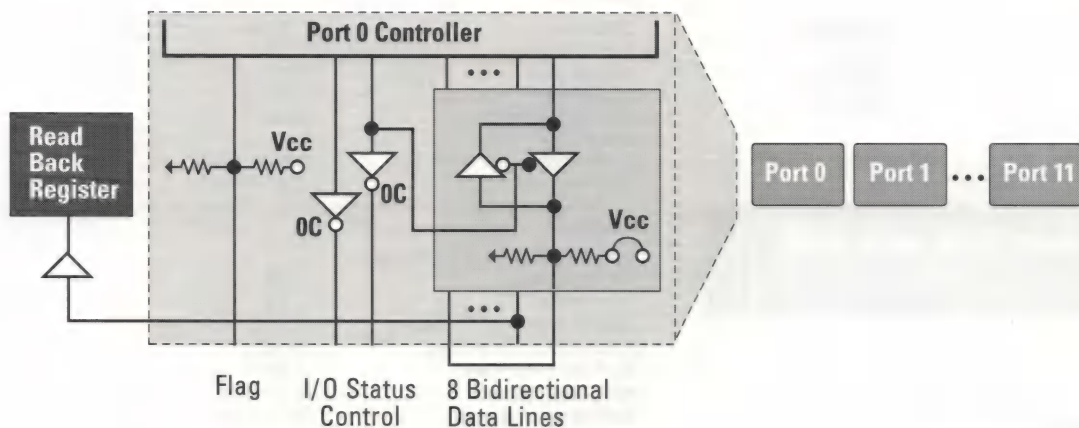
Ordering Information

Description	Product No.
18 Gbyte VXI System Disk with DAT Drive	E3249B
Danish HP-UX 10.2 Instant Ignition	E3249B 010
Dutch HP-UX 10.2 Instant Ignition	E3249B 011
English HP-UX 10.2 Instant Ignition	E3249B 012
Finnish HP-UX 10.2 Instant Ignition	E3249B 013
French HP-UX 10.2 Instant Ignition	E3249B 014
German HP-UX 10.2 Instant Ignition	E3249B 015
Italian HP-UX 10.2 Instant Ignition	E3249B 016
Japanese HP-UX 10.2 Instant Ignition	E3249B 017
Korean HP-UX 10.2 Instant Ignition	E3249B 018
Norwegian HP-UX 10.2 Instant Ignition	E3249B 019
Simplified Chinese HP-UX 10.2 Inst. Ign.	E3249B 020
Spanish HP-UX 10.2 Instant Ignition	E3249B 021
Swedish HP-UX 10.2 Instant Ignition	E3249B 022
Traditional Chinese HP-UX 10.2 Inst. Ign	E3249B 023
Configure for 500 MB swap space	E3249B 031
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E3249B W01

Publication No.: 5965-6872E

Overview

Agilent E1458A Block Diagram



13

Data Generator/Analyzer

Product No.	Description
81200	Data Generator/Analyzer Platform

B-Size Digital I/O Modules

Product No.	Description
E1330B	Quad 8-Bit Digital Input/Output
E1339A	72-Channel Digital Output/Relay Driver

C-Size Digital I/O Modules

Product No.	Description
E1452A	Terminating 20 MHz Pattern I/O Module
E1458A	96-Channel Digital I/O Card, VXI C-Size
E1459A	64-Channel Isolated Digital Input/Interrupt Module

Introduction

Digital modules are used to:

- send or receive pattern data from the device under test (DUT) as part of a functional test routine,
- sense and control devices or custom equipment in your test system,
- characterize the design of a device by stimulating it with varying input parameters and reading the resulting performance.

Important parameters for your digital modules are the number of digital lines available, the drive capability of those lines, and the rate you need to input and output digital data. Agilent Technologies has several digital modules to meet the needs of your application.

Overview: High-Performance Data Generator/Analyzer

The Agilent 81200 allows you to push new devices to the limit with up to 240 channels of data generation and analysis. You can perform comprehensive digital testing at rates ranging from 1 kb/second to 2.67 Gb/second. The 81200 gives you full control of pulse parameters for each individual channel. You can use the Agilent 81200 to generate the data to stimulate your DUT, capture the result, and then compare the actual with the expected data in real time for a synchronized, immediate evaluation.

Overview: Digital I/O Module Choices

Agilent offers several B- and C-size digital I/O modules to meet your needs for digital sensing and control, and low-speed digital stimulus and functional testing.

The E1330B Quad 8-bit Digital Input/Output module provides versatile digital sensing and control of simple digital devices through its bi-directional data lines. Six handshake types are available, including standard GPIO modes. The E1339A 72-Channel Digital Output/Relay Driver can be used as digital outputs or as drivers for external relays.

The E1458A 96-Channel Digital I/O module, functionally similar to the E1330B, provides the same versatile bi-directional lines and digital sensing, but is intended for larger applications in data acquisition and control or digital subassembly test. The E1459A 64-Channel Isolated Digital Input/Interrupt module is used to sense dc levels and edge transitions up to 48 Vdc.

The Agilent E1452A Pattern I/O module can be used standalone as a higher-speed pattern generator. The E1452A provides 32 I/O pins arranged in four 8-bit ports, capable of data rates up to 20 MHz. Each port can be statically programmed to output, record or perform a real-time compare.

Family Specifications

Model	E1330B	E1339A	E1452A	E1458A	E1459A
	Quad 8-Bit Digital I/O	72-Channel Digital Output/Relay Driver	Terminating 20 MHz Pattern I/O Module	96-Channel Digital I/O	64-Channel Digital Input/Interrupt
VXI Characteristics					
Size:	B	B	C	C	C
Slots:	1	1	1	1	1
VXI device type:	Register based	Register based	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.					
VXIplug&play Win Framework:	Yes	No	No	Yes	No
VXIplug&play Win 95/NT Framework:	Yes	Yes	No	Yes	Yes
VXIplug&play HP-UX Framework:	No	No	No	No	No
Specifications					
Number of channels:	32	72	32	96	64
Channel type:	Input or Output	Output	Input or Output	Input or Output	Input
Output or Input:	TTL	Open Collector	TTL/CMOS	TTL	Variable
Memory:	None	n/a	64 K-vectors	None	n/a
32-bit block transfer:	325 Kb/s	n/a	n/a	325 Kb/s	n/a
Test synchronization:	Software triggers, hardware handshaking	n/a	Hardware triggers, software triggers	Software triggers, hardware handshaking	n/a

Data Generator/Analyzer Platform

Agilent 81200



Agilent 81200

- Up to 240 channels of data generation and analysis
- 1 kb/second to 2.67 Gb/second
- Full control of pulse parameters for each individual channel
- Flexible and scaleable platform

Description

The Agilent 81200 allows you to push new devices to the limit with comprehensive signal testing. The 81200 Data Generator/Analyzer Platform is the right choice for you if you are an engineer in R&D or manufacturing performing functional and parametric tests on digital subsystems, ICs, or boards. The 81200 allows thorough verification and characterization of digital devices throughout the development cycle, thus reducing risks, costs and time-to-market. The Agilent 81200 is a complete test system for your physical layer testing. It generates the data to stimulate your DUT, captures the result, and then compares the actual with the expected data in real time for a synchronized, immediate evaluation.

Create virtually any test signal you need

Today's devices require very complex stimuli. With sequencing and looping and up to eight million vectors of memory per channel, you can create an infinite variety of stimulus signals. Choose from return-to-zero (RZ), non-return-to-zero (NRZ) and return-to-one (R1) formats. Create even more complex signals with Boolean channel addition including return-to-complement. The internal editor includes memory-based PRBS/PRWS (pseudo-random binary/word sequence) to simulate traffic. The 81200 is ideal for performing parallel bit-error ratio measurements at up to 2.67 Gb/s or for stimulating the digital port of a DAC. This scaleable, modular platform is easily adaptable to changes in your verification and characterization needs.

Verification

The Agilent 81200 covers all of your requirements for functional testing under nominal conditions in R&D and manufacturing. It generates clock and many kinds of simulated data for an extensive range of applications (for example, bus, serial interface, Ethernet LAN, disk drives, radar, optical/wireless/coax interfaces, satellite, video-RAM-DACs, MUXs, digital filters, flat panel display links). It then analyzes and compares the results with what you expected to identify errors and calculate bit-error ratios.

Characterization

When you need to test the performance and reliability of your device under real-world conditions for complete confidence, the Agilent 81200 is there to help you with emulations of nominal and worst-case timings and patterns. It can modify or even automatically sweep the pulse parameters to drive your DUT to its limits. With data rates up to 2.67 Gb/s, the Agilent 81200 has the performance to characterize CMOS, TTL, ECL, and even LVDS devices.

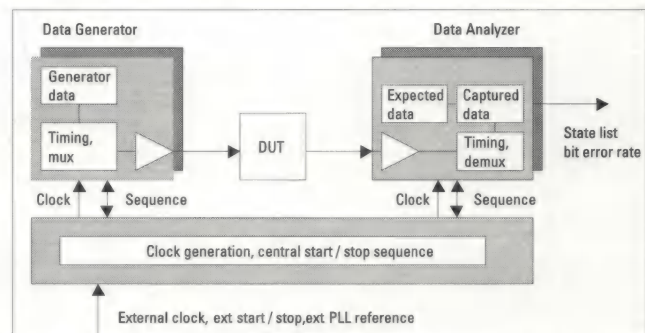
Key Features

- Flexible real-time stimulus and response system
- Easy integration into standard VXI environments
- 333 kHz to 2.67 Gb/s
- Up to 8 Mbit memory per channel
- 2 - 128 RZ channels (doubles for NRZ channels up to 200 Mbit/s)
- Scaleable and upgradeable through modules and front-ends
- 1 ps timing resolution, ± 30 ps edge placement accuracy
- Pattern formats: RZ, R1, NRZ, DNRZ
- PRBS (Pseudo-Random-Bit-Sequence) and PRWS (Pseudo-Random-Word-Sequence) up to 2^{16}
- Sequencing with five looping levels (nested loops)
- Branching on internal and external events
- Variable delays, levels, and transition times can be set separately for each channel
- Semi-automatic de-skew eases test setup
- Measurement modes: capture, error capture, error count
- Measurement result displays: state list, waveform viewer, bit-error-rate
- Intuitive Windows NT 4.0-based GUI
- Remote interfaces: LAN, GPIB
- Programming interfaces: SCPI, VXIplug&play drivers for easy programming

Platform Description

The Agilent 81200 Data Generator/Analyzer Platform is a modular platform which can be tailored to your specific needs, for example, as a pulse generator, single or multi-phase clock generator, a data generator, or as a data generator/analyzer system.

As indicated in the block diagram, each DUT input pin is stimulated by a generator channel with independent data memory, timing and output. The device outputs are sampled by an analyzer channel with individual input threshold, sampling point delay, and memory, for captured and expected data. All data generator and analyzer channels are synchronized by a common system clock and pattern sequence.



Initial setup is easy because the 81200 is supplied ready-to-use. All software and hardware are fully installed. You need only to connect expander frames and peripherals (keyboard, mouse, and monitor) to the mainframe.

Easy integration into your test environment

The 81200 data generator/analyzer modules can be integrated easily into other VXI-based test platforms, and other VXI modules can be configured to work with the 81200 system. VXIplug&play drivers facilitate easy programming and test system integration. For details on integrating the 81200 modules into a standard VXI test system, consult the 81200 Data Generator/Analyzer Platform configuration guide, Pub. No. 5965-3417E.

Configuration and Ordering Information

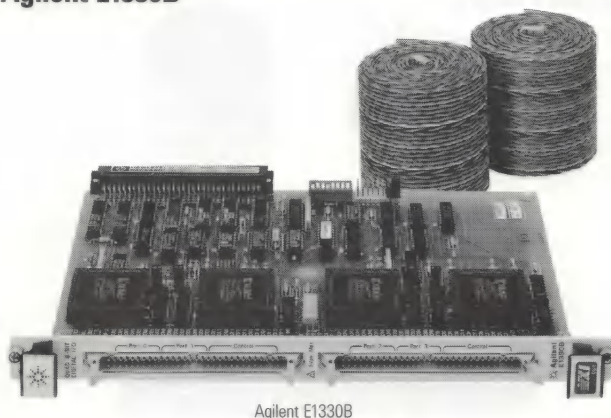
Visit www.agilent.com/find/81200_overview, or see the following publications available from Agilent:

- Agilent 81200 brochure (pub no. 5980-0488E)
- Agilent 81200 data sheet (pub no. 5965-3415E)
- Agilent 81200 configuration guide (pub no. 5965-3417E)

Publication No.: 5965-3415E

Quad 8-Bit Digital Input/Output

Agilent E1330B



Agilent E1330B

- 1-Slot, B-size, register based
- Quad 8-bit input or output data ports
- Interface to industry standard opto-isolator racks
- Standard GPIO handshake modes
- Wide variety of output data types
- Four-port digital input/output module

Description

The Agilent Technologies E1330B Quad 8-bit Digital Input/Output module is a B-size, 1-slot, register-based VXI device. It is a four-port digital input/output module intended for data communication and digital control.

Each 8-bit port is identical consisting of data and handshake/control lines. Each 8-bit port can be configured for output or input and positive or negative true logic. Ports can be combined allowing data transmission using bytes, words (16-bit), and long words (32-bit). Bit data transmissions are also allowed. Three handshake and control lines are provided for each port when using SCPI programming. The flag line from each of the individual ports can be used independently, or they can be combined when using word or long-word data transmission.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Handshake and Control Lines

Three handshake and control lines are provided for each port when using SCPI programming. These lines provide the following functions: **FLG** Flag line. Data handshaking line input to the digital I/O module. **CTL** Control line. Data handshaking line output by the digital I/O module. **I/O** Input/output status line. Output line on the module describing the current status of the port.

The flag line from each of the individual ports can be used independently, or they can be combined when using word or long-word data transmission.

Each port has three additional control lines available for custom handshaking and interrupt functions: **PIR** (peripheral interrupt), **/RES** (peripheral reset), and **STS** (status). Control of these three lines is accomplished using register-based programming.

C-size Adapter

For adapting this product to a C-size mainframe, refer to the section on Accessories in this catalog for a description of the E1403C Adapter.

Product Specifications

General

Number of channels:	32
Channel type:	Input or Output
Output or input type:	TTL
Memory:	none
Max. pattern rate:	n/a
Max. pattern rate:	325 Kb/s
Test synchronization:	Software triggers, hardware handshaking
Logic levels:	TTL compatible, 5 V max

Data Lines

Output characteristics:

I_{out} (High): -5.2 mA @ $V_{out} = 2.5$ V (Pullup Enabled)

I_{out} (Low): 48 mA @ $V_{out} = 0.5$ V

Input characteristics:

I_{in} (High): <2.5 mA @ $V_{in} = 2.5$ V

I_{in} (Low): <-3.2 mA @ $V_{in} = 0.4$ V

V_{in} (High): >2.0 V (5.0 V max)

V_{in} (Low): <0.8 V

Handshake Lines

Output characteristics:

I_{out} (High): 250 μ A @ V_{out} (High) = 5 V

I_{out} (Low): 40 mA @ V_{out} (Low) = 0.7 V

I_{out} (Low): 16 mA @ V_{out} (Low) = 0.4 V

Input characteristics:

V_{in} (High): >2.0 V

V_{in} (Low): <0.8 V

I_{in} (Low): <1.75 mA

Block Mode Transfers

8-bit wide: @ 90 KB/s

32-bit wide: @ 325 KB/s

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A16/D16 slave
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	No
VXI buses:	No
C-size compatibility:	Yes, with E1403C Adapter

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.03
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.5	0.01
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

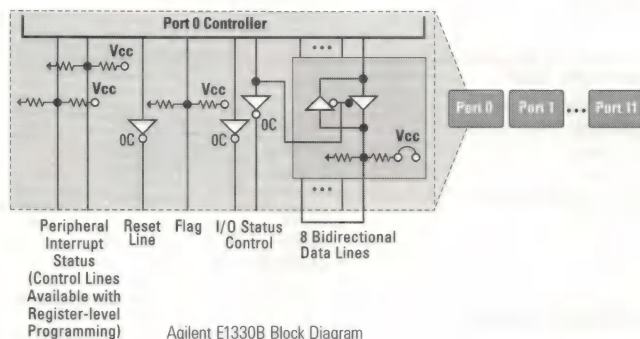
Cooling/Slot

Watts/slot:	2.50
ΔP mm H ₂ O:	0.04
Air Flow liter/s:	0.21

(Agilent E1330B continued)

Ordering Information

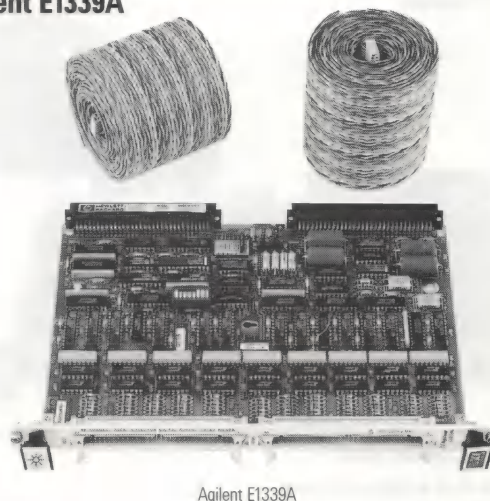
Description	Product No.
Quad 8-bit Digital Input/Output	E1330B
Service Manual	E1330B 0B3
Japan - Japanese Localization	E1330B ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1330B W01
Cable Assy Ribbon 60P	E1330-61601



Publication No.: 5965-5556E

72-Channel Digital Output/Relay Driver

Agilent E1339A



- 1-Slot, B-size, register based
- Digital output or dense relay driver
- Open Collector outputs switch up to 32 V
- Relay coil flyback protection
- Power for driver external devices
- Output cables supplied

Description

The Agilent Technologies E1339A 72-Channel Digital Output/Relay Driver is a B-size, 1-slot, register-based VXI module. Channels can be used (with external pull-up resistors) as digital outputs or as drivers for external relays.

All channels are referenced to chassis ground, can sink up to 200 mA each, and can switch voltages up to 32 V. Limited power is available on the module faceplate for powering external devices. An on-board jumper permits either the +5, +12, or +24 V VXI power supplies to be used for powering external devices.

Please note that +24 volt power is not available on Agilent B-size VXI mainframes. If +24 volt load power is required in such a case, an external power supply may be used. +24 volt power is available on Agilent C-size mainframes.

The downloadable SCPI and VXIplug&play drivers provide open/close commands for individual 72-channel operation or for 36-channel dual output operation (the latter is designed specifically for driving latching microwave relays).

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Connectors

User connection to the E1339A is implemented through two 60-pin faceplate ribbon cable headers with cable securing clips/extractors. Two 2-meter long-twisted pair ribbon mating cables with ribbon connectors are supplied with the module. The user-end of these cables is unterminated.

C-size Adapter

For adapting the E1339A to a C-size mainframe, the E1407A Adapter is recommended.

Product Specifications

General

Number of channels:	72
Channel type:	Output
Output or input type:	Open collector
Sink current per channel:	200 mA
Maximum open collector voltage:	32 V
Maximum available current (only one of the three internal power supplies can be selected):	
+5 V:	1 A (fused and requires P2)
+12 V:	1 A (fused)
+24 V:	1 A (fused and requires P2)

(Agilent E1339A continued)

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	n/a
Size:	B
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None
C-size compatibility:	Yes, requires E1407A

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-CSPI Lynx OS:	No
C-CSPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	0.10	0.10
+12 V:	0.10	0.01
-12 V:	—	—
+24 V:	—	—
-24 V:	—	—
-5.2 V:	—	—
-2 V:	—	—

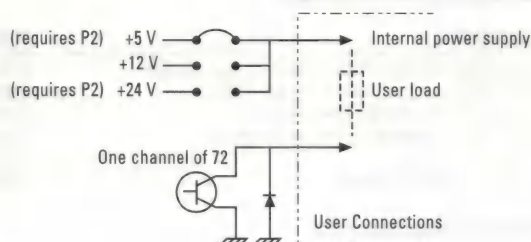
Cooling/Slot

Watts/slot:	6
ΔP mm H ₂ O:	0.05
Air flow liter/s:	0.42

Ordering Information

Description	Product No.
72-Channel Digital Output/Relay Driver	E1339A
Service Manual	E1339A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1339A W01

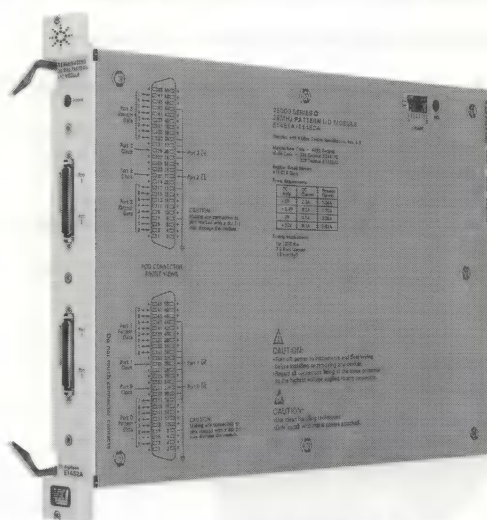
E1339A Circuit Diagram



Publication No.: 5965-8831E

Terminating 20 MHz Pattern I/O Module

Agilent E1452A



Agilent E1452A

- 32 I/O pins (4 ports of 8 bits each)
- Maximum 20 MHz pattern rate using an external clock
- 64 K segmentable pattern depth
- Output, record, real-time comparison per port
- Programmatic or triggered tri-state on the fly

Description

The Agilent E1452A Pattern Input/Output Module is a C-size, 1-slot, register-based VXI module that is used to send data to and receive data from a device under test. Since it does not contain an internal time base, the E1452A is clocked by an externally supplied signal.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Programming

The pattern I/O module must be programmed using the SCPI instrument control language. Therefore, your VXI system requires an Agilent E1406A Command Module and a downloadable SCPI driver. Register-based programming is not supported.

32 Input/Output Pins per Module

Each pattern module contains 32 I/O pins arranged in four ports of eight bits. Each port can be statically programmed to output, record, or perform a real-time compare. Each port can also be tri-stated on the fly, either programmatically or externally. This allows two ports to be paralleled for bi-directional data transfers or to double I/O speed.

Deep Memory

The pattern module contains 64 KB of memory behind each I/O port. This memory is segmentable and may be dedicated to one large test or split into multiple tests. **Note:** This memory is not dual-ported FIFO memory. Instead, generator/capture activity must be stopped when reading or writing to the memory.

(Agilent E1452A continued)

Connecting the E1452A to the DUT

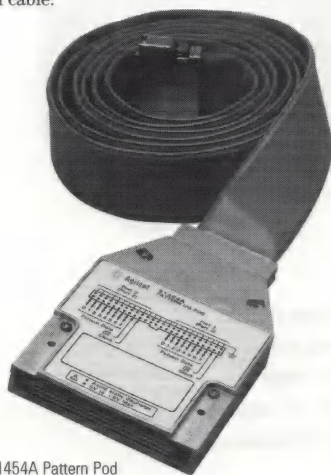
The Agilent E1454A Pattern Pod is a 16-pin active device with a 2-meter cable. This pod allows for full drive capability at a 2-meter distance from the module.

There are two basic ways to connect the pattern I/O module to the DUT:

(1) Using the Agilent E1454A Pattern Pod and making a connection to the pattern pod via:

- The E1493-61601 Pod Cable Assembly, which provides a mating connector for the pattern pod's connector and 61 cm of ribbon cable.
- The 1251-8832 right-angle PC board connector, which mates to the pattern pod's connector. The 1251-8832 connector is a 2x25-pin, male dual in-line connector (3M 3596-5002).
- The 1251-8262 straight PC board connector, which mates to the pattern pod's connector. The 1251-8262 connector is a 2x25-pin, male dual in-line connector (3M 3596-6002).

(2) Direct connection to the pattern I/O module's front panel connector via the E1454-61601 Pattern Module Cable Assembly or by a user-supplied connector and cable.



Agilent E1454A Pattern Pod

Product Specifications

Specifications include the E1454A pod and apply with a 50 pf, 500 Ω (to ground) load.

General

Number of channels:	32
Channel type:	Input or Output
Output or input type:	TTL/CMOS
Memory:	64 K-vectors
Max. pattern rate:	20 M/s
32-bit block transfer:	n/a
Test synchronization:	Hardware triggers, software triggers

Memory

Depth:	65,536 (64 k) vectors
--------	-----------------------

Timing

Pattern rate:	See external clock specifications
Skew:	3 ns typical (between I/O Pins, same port)
Rise time:	6.5 ns typical
Fall time:	7.0 ns typical

Output Levels

High, open circuit:	4.4 V min
Low, open circuit:	0.1 V max
High, sourcing 24 mA:	3.7 V min
Low, sinking 24 mA:	0.44 V max

Input Levels

High:	>2.0 V
Low:	<0.8 V

Tri-state Control Input Levels

High:	>2.0 V
Low:	<0.8 V

External Tri-state Delay

With pod:	11 ns max
Without pod:	14 ns max

External Clock

Minimum pulse width:	6 ns
----------------------	------

Input Levels

High:	>2.0 V
Low:	<0.8 V

General Specifications

VXI Characteristics

VXI device type:	Register based
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	No
VXI buses:	Local Bus A (specialized)

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes (not supported on V743)
C-SCPI LynxOS:	No
C-SCPI Series 700:	Yes (not supported on V743)
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	1.5	0.04
+12 V:	0.1	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	2.2	0.2
-2 V:	0.6	0.08

Cooling/Slot

Watts/slot:	22.00
ΔP mm H ₂ O:	0.12
Air Flow liter/s:	2.00

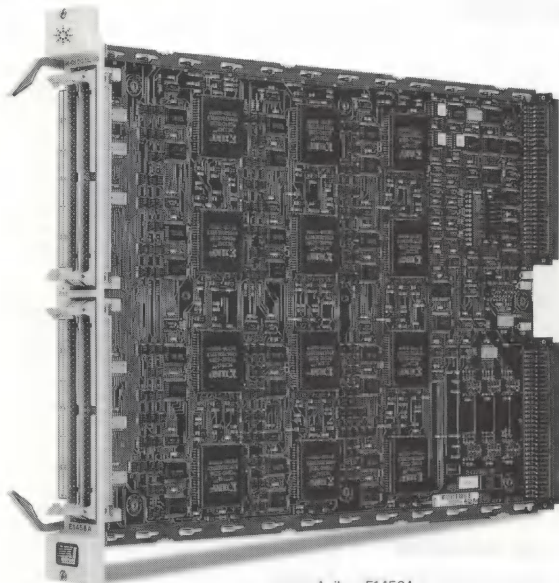
Ordering Information

Description	Product No.
Terminating 20 MHz Pattern Input/Output Module	E1452A
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1452A W01
Pattern I/O Pod for the E1451A/52A	E1454A
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1454A W01
Pattern I/O Cable	E1454-61601
Cable Customer Interface	E1493-61601

Publication No.: 5985-5557E

96-Channel Digital I/O

Agilent E1458A



Agilent E1458A

- 1-Slot, C-size, register based
- Twelve 8-bit input or output data ports for acquisition
- Wide variety of output data types
- Data port readback on a per-port basis
- Control of interface driver tri-state capability
- Block mode transfer to/from memory

Description

The Agilent Technologies E1458A 96-Channel Digital Input/Output module is a C-size, 1-slot, register-based VXI module that offers twelve 8-bit bi-directional data ports. It provides block memory transfers and six GPIO handshake protocols (none, leading edge, trailing edge, pulse, partial, and strobe) for a wide range of applications.

Functionally similar to the E1330B, the E1458A is intended for digital I/O control applications such as digital subassembly test or data acquisition and control. Each of the 12 identical ports consists of eight data lines and six handshake/control lines.

Each 8-bit port is individually configured for positive/negative true logic and read/write or tri-state condition. The E1458A is arranged into three banks of four ports each. Ports can be combined within a bank, allowing data transmission using bytes, words (16-bit), or long words (32-bit). Data transmission can be from a single port (8 bits) or from multiple ports up to all 12 ports.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Handshake and Control Lines

Three handshake and control lines for each port can be controlled with SCPI programming. These lines provide the following functions:

FLAG: Data handshaking line input to the digital I/O module

CTL: Data handshaking line output by the digital I/O module

I/O: Input/output status line

Each port has three additional control lines available for custom handshaking and interrupt functions: **PIR** (peripheral interrupt), **RES** (peripheral reset), and **STS** (status). Control of these three lines is done through register-based programming.

Cables

The E1458A ships with four 2-meter cables. For ordering each additional 2-meter cable, order Agilent part number E1458-61601. An Opto 22 component cable may be ordered separately as Option 022.

SCPI

The E1458A SCPI command set is a superset of the E1330B, allowing existing SCPI application programs to run on the E1458A. The E1458A SCPI command set supports additional queries to read back port data and control values, plus new E1458A capabilities, including monitoring of actual output port data. The E1458A driver is supported on all C-SCPI/I-SCPI platforms and also as a downloadable driver for the Agilent E1406A command modules.

Product Specifications

General

Number of channels:	96
Channel type:	Input or Output
Output or input type:	TTL
Memory:	none
Max. pattern rate:	n/a
32-bit block transfer:	325 Kb/s
Test synchronization:	Software triggers, hardware handshaking
Logic Levels:	TTL compatible, 5 V maximum

Data Lines

Output characteristics:	
I_{out} (High):	-5.2 mA @ $V_{out} = 2.5$ V (pull-up enabled)
I_{out} (Low):	48 mA @ $V_{out} = 0.5$ V
Input characteristics:	
I_{in} (High):	<2.5 mA @ $V_{in} = 2.5$ V
I_{in} (Low):	<-3.2 mA @ $V_{in} = 0.4$ V
V_{in} (Low):	>2.0 V (5.0 V maximum)
V_{in} (Low):	<0.8 V

Handshake Lines

Output characteristics:	
I_{out} (High):	250 μ A @ V_{out} (high): 5 V
I_{out} (Low):	40 mA @ V_{out} (low): 0.7 V
I_{out} (Low):	16 mA @ V_{out} (low): 0.4 V
Input characteristics:	
V_{in} (High):	>2.0 V
V_{in} (Low):	<0.8 V
I_{in} (Low):	<1.75 mA

Block Mode Transfers

8-bit wide:	@ 90 KB/s
32-bit wide:	@ 325 KB/s

General Specifications

VXI Characteristics

VXI device type:	Register based
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	No
VXI buses:	No

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

(Agilent E1458A continued)

Module Current

	I_{PM}	I_{DM}
+5 V:	1.2	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V	0	0
-2 V:	0	0

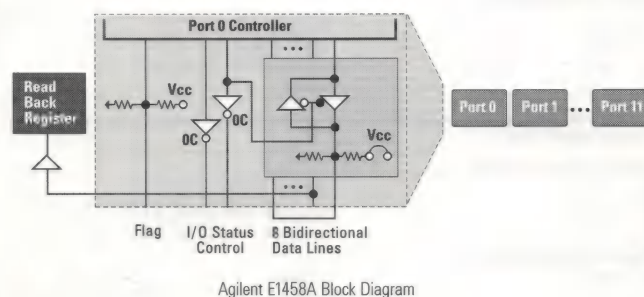
Cooling/Slot

Watts/slot:	2.50
ΔP mm H ₂ O:	0.04
Air Flow liter/s:	0.21

Ordering Information

Description	Product No.
96-Channel Digital Input/Output	E1458A
Opto 22 Components Cable	E1458A 022
Service Manual	E1458A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1458A W01
Additional 2-Meter Cable	E1458-61601

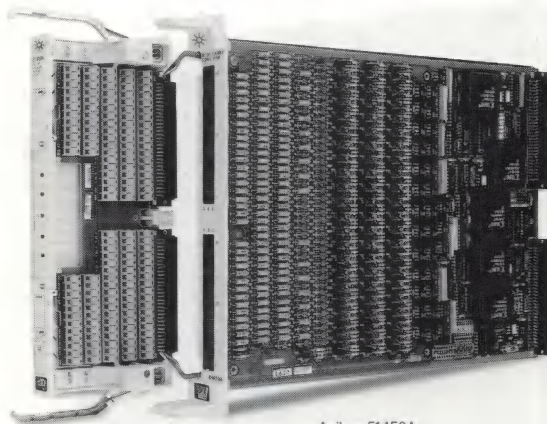
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Publication No.: 5965-5558E

64-Channel Isolated Digital Input/Interrupt

Agilent E1459A



Agilent E1459A

- 1-Slot, C-size, register based
- 64 interrupts, maskable and edge-selectable
- Jumper-selectable input levels
- Time-programmable debounce
- On-board 5 V supply for pull-up capability
- Handshake lines for each word (16 channels)

Description

The Agilent Technologies E1459A 64-Channel Isolated Digital Input/Interrupt is a C-size, 1-slot, register-based VXI module. It is used to sense dc levels and edge transitions up to 48 Vdc. All inputs are optically isolated to withstand up to 125 V rms or Vdc. Plus, using the module's built-in 5 V supply with 9.4 k Ω effective pull-up resistance, you can detect whether external switches are open or closed.

The debounce feature is programmable for periods of 16 μ s to 1074 s in binary increments. Channel groups 1 to 32 and 33 to 64 can each have a unique programmed debounce period.

Each word (16-bit/channel) has strobe in, ready for data, and interrupt out. Strobe-in lines can be connected in parallel for 32- or 64-bit transfers.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Voltages:	5, 12, 24, 48 Vdc
Threshold:	
Minimum:	1, 2.5, 7, 14
Maximum:	4, 9.5, 17, 31
Currents:	0.5, 1.3, 2.8, 5.8 mA (at nominal voltages)
Maximum input voltage:	60 Vdc (Between High and Low terminal of each channel), 125 V rms or Vdc (Between channels or between any terminal and chassis)
Minimum input pulse width:	100 ms + debounce time
Debounce:	Programmable from 16 μ s to 1074 s

Output

5 volt supply:	4.5 to 5.5 Vdc (at 32 mA total maximum)
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(Agilent E1459A continued)

General Characteristics

Number of channels:	64
Channel type:	Input
Output or input type:	Variable
Memory:	n/a
Max. pattern rate:	n/a
32-bit block transfer:	n/a
Test synchronization:	n/a
Typical time to read 16-bit word:	1 ms, using register access
Terminal module:	Removable, with screw-type terminals
Maximum wire size:	16 AWG (1.5mm)

General Specifications**VXI Characteristics**

VXI device type:	Register based
Data transfer bus:	A16, slave only
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	0.19	0.10
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.05
Air flow liter/s:	0.42

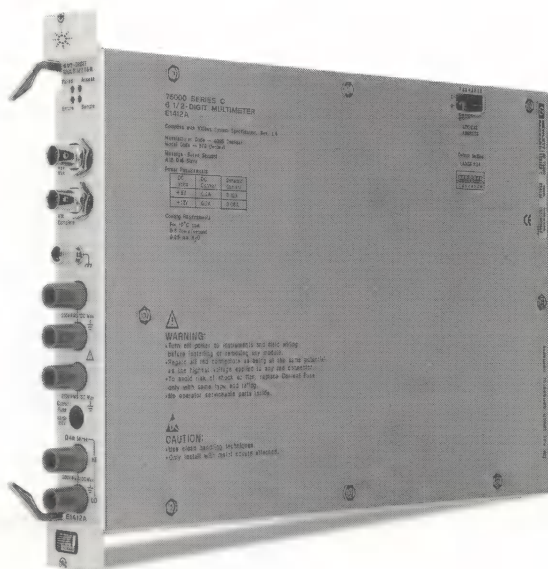
Ordering Information

Description	Product No.
64-Channel Isolated Digital Input/Interrupt	E1459A
Service Manual	E1459A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1459A W01

Publication No.: 5965-8832E

Overview

Agilent E1412A Digital Multimeter



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B-Size Module

Product No.	Description
E1326B	5.5-Digit Multimeter, High Accuracy

C-Size Modules

Product No.	Description
E1411B	5.5-Digit Multimeter, High Accuracy
E1412A	6.5-Digit Multimeter, High Accuracy
E1416A	Power Meter C-Size VXI

Introduction

Whether you're in product development, manufacturing, or field repair, you need test equipment that has what you need to get the job done right! Agilent Technologies' digital multimeters (DMM) come packed with the performance and flexibility you need. So, from a toolbox to a test rack, or to a VXI test system, there's an Agilent DMM that's right for your job.

Overview: Digital Multimeter Choices

What does performance in a DMM mean to you? Agilent answers this question with resolution, precision, sensitivity, and measurement speed. And, all Agilent's DMM modules provide these performance measures. Another important feature of your DMM is flexibility. Agilent provides DMMs with the flexibility for you to perform many different tasks. This includes everything from the basics to advanced functions (min./max./avg. readouts) to letting you balance speed, resolution, and noise rejection for each test.

Agilent offers a DMM in B-size (E1326B) for low-cost, high-performance multimeters, and in C-size (E1411B and E1412A) for wide functionality with standard measurements as well as volts, amps, ohms, and frequency. In fact, the E1412A 6.5-Digit Multimeter provides the widest functionality in Agilent's DMM line!

In addition to wide functionality, with the E1411B and E1326B, you can trade-off between measurement performance and throughput. Using the integrating A/Ds in these multimeters, you can make 5.5-digit, low-noise measurements, or switch to their sampling A/Ds and make 14-bit readings at rates up to 13 kHz.

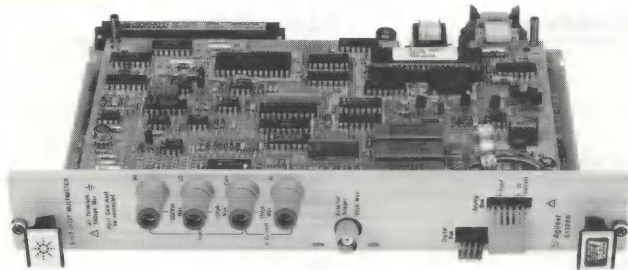
Agilent also offers the E1416A Power Meter for your specialized measurement needs. With its powerful programming capability, state-of-the-art accuracy and exceptional reliability, you can measure your test signals with speed, precision, and confidence.

Family Specifications

Model	E1326B	E1411B	E1412A
	5.5-Digit Multimeter	5.5-Digit Multimeter	6.5-Digit Multimeter
VXI Characteristics			
Size:	B	C	C
Slots:	2	1	1
VXI Device Type:	Register based	Register based	Message based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.			
VXIplug&play Win Framework:	Yes	Yes	Yes
VXIplug&play Win 95/NT Framework:	Yes	Yes	Yes
VXIplug&play HP-UX Framework:	No	No	No
Specifications			
Digits:	5.5	5.5	6.5
dc Voltage:	300 V	300 V	300 V
Voltage accuracy (dc):	$\pm 0.0145\%$	$\pm 0.0145\%$	$\pm 0.0019\%$
ac voltage:	300 V	300 V	300 V
Voltage accuracy (ac):	$\pm 0.84\%$	$\pm 0.84\%$	$\pm 0.07\%$
2/4-wire Ω :	1 M Ω	1 M Ω	100 M Ω
Max. reading rate:	13 K	13 K	1 K
Functions			
Idc:	—	—	3 A
Iac:	—	—	3 A
Frequency:	—	—	300 kHz
Period:	—	—	3.3 μ s
Temperature:	Tm, Tc, RTD	Tm, Tc, RTD	—

5.5-Digit Multimeter, B-Size

Agilent E1326B



Agilent E1326B

- 2-Slot, B-size, register based
- DCV, ACV, 2- & 4-wire Ω , temperature
- 5.5-digit low-noise integrating A/D
- 13 kHz high-speed sampling A/D
- Balanced differential isolated inputs
- Software calibration

Description

The Agilent Technologies E1326B autoranging 5.5-Digit Multimeter is a **B-size, 2-slot, register-based VXI module**. It is identical in electrical design to the E1411B, differing only in size. The E1326B can be used in the E1300/01B mainframes. Using the Internal Installation Kit (E1326-80004) or Option 009 when ordering the E1300/01B, the E1326B can be mounted internally in the E1300/01B mainframes (saving two module slots). This instrument is especially well suited for data acquisition and computer-aided test applications.

This module can be used as an integrating A/D to make 5.5-digit, low-noise measurements, or switch to the sampling A/D to make 14-bit readings at rates up to 13 kHz. When combined with any Agilent VXI relay or FET multiplexer, you can create a multichannel scanning multimeter. By sending just one SCPI command to the E1300/01B mainframe built-in command module, you can program the multimeter and the channels of your multiplexers at one time. The E1326B provides flexible triggering with built-in timer pacer.

Product functions for the E1326B include DCV, ACV Offset-compensated Ohm, Thermocouples, Thermistors, and RTDs.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Reading rate

Auto zero off, fixed range, default trigger delay, offset comp off, Sample Source "TIMER" for rates >15 readings/s.

Max. reading rate: 13 K

Typical Reading Rates (rdgs/s)

	320 ms	267 ms	20 ms	Aperture 16.7 ms	2.5 ms	100 μ s	10 μ s
dc voltage:	3	3.5	49	59	365	3125	13000
Four-wire resistance:	3	3.5	49	59	365	3125	13000
ac voltage:	1.3	1.4	1.9	1.9	1.9	1.9	1.9

Resolution (bits/digits)

	320 ms	267 ms	20 ms	Aperture 16.7 ms	2.5 ms	100 μ s	10 μ s
Binary bits:	± 22	± 22	± 20	± 20	± 18	± 15	± 14
Decimal digits:	6.5	6.5	6	6	5.5	4.5	4

Noise rejection (dB)

Noise Rejection Conditions: CMR measured with 1 k Ω in both HIGH and LOW leads with a 10% imbalance, LOW connected to COMMON at source, measured with respect to earth ground. NMR is for specified frequencies $\pm 0.1\%$.

		320 ms	267 ms	20 ms	Aperture 16.7 ms	2.5 ms	100 μ s	10 μ s
dc voltage & resistance:								
dc:	Common mode rejection	150 dB	150 dB	150 dB	150 dB	150 dB	150 dB	150 dB
50 Hz:	Power line cycles (NPLCs)	16	—	1	—	—	—	—
	Normal mode (50 Hz) rejection	84 dB	0 dB	60 dB	0 dB	0 dB	0 dB	0 dB
60 Hz:	Power line cycles (NPLCs)	—	16	—	1	—	—	—
	Normal mode (60 Hz) rejection	0 dB	84 dB	0 dB	60 dB	0 dB	0 dB	0 dB
400 Hz:	Power line cycles (NPLCs)	128	—	8	—	1	—	—
	Normal mode (400 Hz) rejection	84 dB	0 dB	84 dB	0 dB	60 dB	0 dB	0 dB
ac voltage:								
dc to 400 Hz:	Common mode rejection	110 dB	110 dB	110 dB	110 dB	110 dB	110 dB	110 dB

(Agilent E1326B continued)

dc VoltageAccuracy Conditions: Auto zero on, one hour warmup. Temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

Range	Input Resistance	Resolution vs Aperture (Ω) (Volts)		90-Day Accuracy vs Aperture \pm (% of Reading)	
		20/16.7 ms	10 μs	20/16.7 ms	10 μs
125 mV	>100 M Ω	120 nV	7.6 μV	0.023% + 5 μV	0.115% + 60 μV
1 V	>100 M Ω	1.0 μV	61 μV	0.013% + 15 μV	0.1% + 200 μV
8 V	>100 M Ω	7.6 μV	488 μV	0.01% + 50 μV	0.1% + 1.5 mV
64 V	10 M $\Omega \pm 5\%$	61 μV	3.9 mV	0.015% + 1 mV	0.1% + 20 mV
300 V	10 M $\Omega \pm 5\%$	488 μV	31 mV	0.015% + 5 mV	0.1% + 80 mV
dc voltage:		300 V max.			
Voltage accuracy (dc):		0.0145%			

Four Wire ResistanceAccuracy Conditions: Auto zero on, one hour warmup. Temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

Range	Source Current	Maximum Open Circuit Voltage	Resolution vs Aperture (Ω)		90-Day Accuracy vs Aperture \pm (% of Reading)	
			20/16.7 ms	10 μs	20/16.7 ms	10 μs
256 Ω	488 μA	11.5 V	250 $\mu\Omega$	15 m Ω	0.035% + 10 m Ω	0.12% + 50 m Ω
2 k Ω	488 μA	11.5 V	2 m Ω	125 m Ω	0.025% + 20 m Ω	0.1% + 200 m Ω
16 k Ω	61 μA	11.5 V	15 m Ω	1 Ω	0.025% + 200 m Ω	0.1% + 2 Ω
131 k Ω	61 μA	11.5 V	125 m Ω	8 Ω	0.025% + 1 Ω	0.1% + 16 Ω
1 M Ω	7.6 μA	11.5 V	1 Ω	64 Ω	0.025% + 10 Ω	0.1% + 120 Ω

True RMS ac Voltage (ac coupled)

Crest Factor: 7 at 10% full scale; 1.5 at full scale.

Accuracy Conditions: Sine wave inputs >10% of full scale. dc component <10% of ac component. Auto-zero on, 1 hour warmup. Temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

Range (RMS)	Input Impedance	Frequency	Resolution vs Aperture (Volts)		90-Day Accuracy vs Aperture ± (% of Reading + Volts)	
			320/267 ms	10 μs	320/267 ms	All other apertures
87.5 mV	>100 MΩ, <100 pF	20-50 Hz	30 nV	7.6 μV	2.175% + 200 μV	2.175% + 1 mV
		50 Hz-1 kHz			0.675% + 200 μV	0.675% + 200 μV
		1-5 kHz			0.675% + 200 μV	0.675% + 200 μV
		5-10 kHz			3.175% + 200 μV	3.175% + 200 μV
700 mV	>100 MΩ, <100 pF	20-50 Hz	0.24 μV	61 μV	2.125% + 1.5 mV	2.125% + 8 mV
		50 Hz-1 kHz			0.625% + 1.5 mV	0.625% + 1.5 mV
		1-5 kHz			0.625% + 1.5 mV	0.625% + 1.5 mV
		5-10 kHz			3.125% + 1.5 mV	3.125% + 1.5 mV
5.6 V	>100 MΩ, <100 pF	20-50 Hz	2.0 μV	488 μV	2.125% + 15 mV	2.125% + 80 mV
		50 Hz-1 kHz			0.625% + 15 mV	0.625% + 15 mV
		1-5 kHz			1.125% + 15 mV	1.125% + 15 mV
		5-10 kHz			10.125% + 15 mV	10.125% + 15 mV
44.8 V	10 MΩ ± 5%, <100 pF	20-50 Hz	15 μV	3.9 mV	2.125% + 100 mV	2.125% + 500 mV
		50 Hz-1 kHz			0.625% + 100 mV	0.625% + 100 mV
		1-5 kHz			1.125% + 100 mV	1.125% + 100 mV
		5-10 kHz			10.125% + 100 mV	10.125% + 100 mV
300 V	10 MΩ ± 5%, <100 pF	20-50 Hz	122 μV	31 mV	2.125% + 500 mV	2.125% + 2.5 V
		50 Hz-1 kHz			0.625% + 500 mV	0.625% + 500 mV
		1-5 kHz			1.125% + 500 mV	1.125% + 500 mV
		5-10 kHz			10.125% + 500 mV	10.125% + 500 mV
ac voltage:		300 V max.				
Voltage accuracy (ac):		0.84%				

Timing/Synchronization

Timer/pacer:	
Timer range:	76 μs to 65.5 ms
Resolution:	2 μs
Programmable delay:	
Delay range:	40 μs to 16 s
Resolution:	2 μs
External trigger:	
Minimum pulse width:	100 ns
Maximum trigger rate:	5 kHz (Trigger Condition, negative edge; Fixed range, 10 μs aperture)

Typical Reading Storage

Agilent 75000 Mainframe:	# of Readings
Series B with standard memory:	50,000
Series B with 512 KB memory (E1300/01B Opt 11):	100,000
Series B with 1 MB memory (E1300/01B Opt 11):	200,000

Isolation

450 Vpk between any Terminal and Chassis

(Agilent E1326B continued)

dc Voltage Accuracy with Relay Multiplexers

Accuracy Conditions: Auto zero on, one hour warmup. Temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

Range	90-Day Accuracy vs Aperture \pm (% of Reading + Volts)		
	E1326B & E1345A / 47A	E1326B & E1346A	
	20/16.7 ms	10 μs	20/16.7 ms
125 mV	0.023% + 9 μV	0.115% + 64 μV	0.023% + 55 μV
1 V	0.013% + 19 μV	0.1% + 204 μV	0.013% + 65 μV
8 V	0.01% + 54 μV	0.1% + 1.5 mV	0.01% + 100 μV
64 V	0.015% + 1 mV	0.1% + 20 mV	0.015% + 1.05 mV
300 V	0.015% + 5 mV	0.1% + 80 mV	0.015% + 5.05 mV

True RMS ac Voltage (ac coupled) with Relay Multiplexers

1-5 kHz and 5-10 kHz frequencies (all apertures) when using Relay Multiplexers (E1343A, E1345A, E1346A, or E1347A). Add 0.2% to the ac Voltage specifications.

Four Wire Resistance with Relay Multiplexers

Accuracy Conditions: Auto zero on, one hour warmup, temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

Note: With offset compensation on, accuracy is the same as for the voltmeter alone. Accuracy data includes all errors contributed by the multimeter, analog bus ribbon cables, multiplexer, and transducer linearizations (if applicable). The accuracies do not include transducer accuracy errors.

**90-Day Accuracy vs Aperture
 \pm (% of reading + Ω)
E1326B & E1345A / 47A**

Range	20/16.7 ms	10 μs
256 Ω	0.035% + 18.2 m Ω	0.12% + 58.2 m Ω
2 k Ω	0.025% + 28.2 m Ω	0.1% + 208 m Ω
16 k Ω	0.025% + 266 m Ω	0.1% + 2.1 Ω
131 k Ω	0.025% + 1.1 Ω	0.1% + 16.1 Ω
1 M Ω	0.025% + 10.5 Ω	0.1% + 121 Ω

Functions

Temp: Tm, Tc, RTD

Temperature

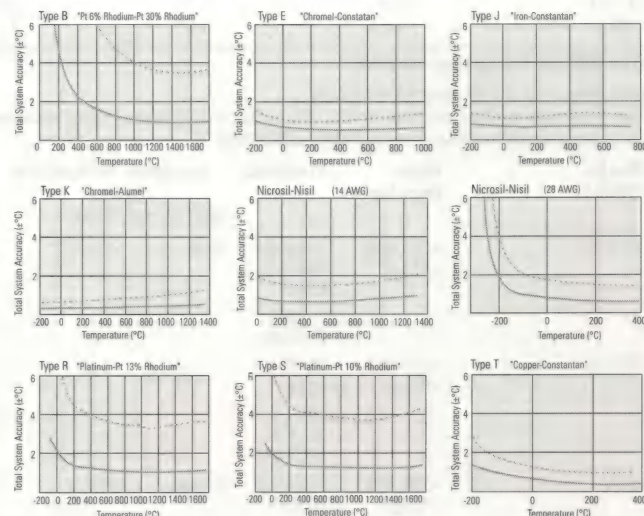
The temperature accuracy graphs (below) include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS 90 standard transducer curves. Add your transducer accuracy to determine total measurement error.

Note: The E1300/01B mainframes, E1406A command modules and Agilent embedded VXI controllers provide units conversion; if the E1411B or E1326B is register-programmed, your program must make the necessary units conversion.

Thermocouples

(E1326B Multimeter and E1347A/E1476A TC MUX):
16 ms aperture (1 PLC):

100 μs aperture:

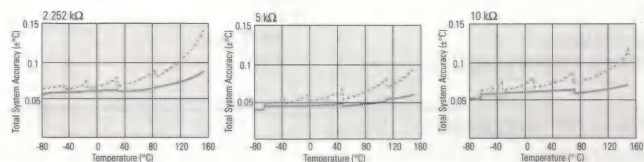
**Thermistors**

(E1326B Multimeter and E1345A/E1347A/E1476A MUXs):

4-wire Ω :

16 ms aperture (1 PLC):

100 μs aperture:



(Agilent E1326B continued)

RTDs

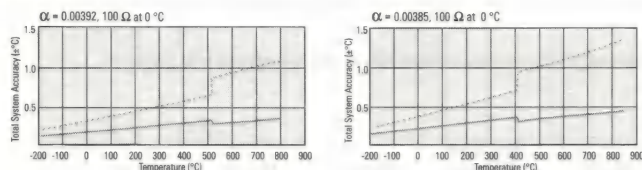
(E1326B Multimeter and E1345A/E1476A MUXs):

4-wire Ω :

16 ms aperture (1 PLC):

100 μ s aperture:

Note: The E1344A High-Voltage MUX also does TC measurements, but with slightly less accuracy.



General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	
Size:	B
Slots:	2
Connectors:	P1
Shared memory:	Yes (available with E1406A/E1300B/E1301B SCPI driver)
VXI buses:	n/a
C-size compatibility:	Yes

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.2	0.1
+12 V:	0.55	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

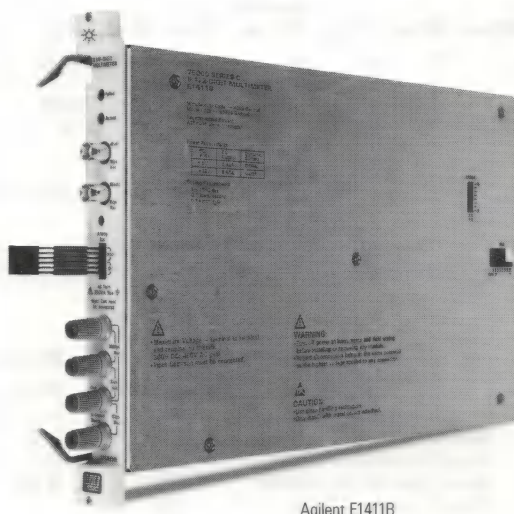
Watts/slot:	4.20
ΔP mm H ₂ O:	0.07
Air Flow liter/s:	0.35

Ordering Information

Description	Product No.
5.5 Digit, Multimeter B-Size	E1326B
Service Manual	E1326B 0B3
Mil Std 45662A Calibration w/Test Data	E1326B 1BP
Japan - Japanese Localization	E1326B ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1326B W01
Internal Installation Kit for E1326B DVM	E1326-80004
Kit-Binding Post	E1326-80005
Publication No.: 5965-5560E	

5.5-Digit Multimeter, C-Size

Agilent E1411B



Agilent E1411B

- 1-Slot, C-size, register based
- DCV, ACV, 2- & 4-wire Ω , temperature
- 5.5-digit low-noise integrating A/D
- 13 kHz high-speed sampling A/D
- Balanced differential isolated inputs
- Software calibration

Description

The Agilent Technologies E1411B 5.5-Digit Multimeter is a **C-size, 1-slot, register-based VXI module**. It is identical in electrical design to the E1326B, differing only in size. You can use the integrating A/D to make 5.5-digit, low-noise measurements, or switch to the sampling A/D to make 14-bit readings at rates up to 13 kHz.

When combined with any Agilent VXI relay or FET multiplexer, you can create a multichannel scanning multimeter. For example, by sending just one SCPI command to the E1406A, you can program the multimeter and the channels of your multiplexers all at one time. The E1411B provides flexible triggering with built-in timer pacer, also.

Product functions for this DMM include Vdc/ac, 2- and 4-wire Ω , offset-compensated Ω , thermocouples, thermistors, and RTDs. This autoranging DMM is especially well suited for data acquisition and computer-aided test applications.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Max. reading rate:	13 K
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Reading Rate

Auto zero off, fixed range, default trigger delay, offset comp off, Sample Source "TIMER" for rates >15 readings/s.

(Agilent E1411B continued)

Typical Reading Rates (rdgs/s)

	320 ms	267 ms	20 ms	Aperture 16.7 ms	2.5 ms	100 μ s	10 μ s
dc voltage:	3	3.5	49	59	365	3125	13000
Four-wire resistance:	3	3.5	49	59	365	3125	13000
ac voltage:	1.3	1.4	1.9	1.9	1.9	1.9	1.9

Resolution (bits/digits)

	320 ms	267 ms	20 ms	Aperture 16.7 ms	2.5 ms	100 μ s	10 μ s
Binary bits:	± 22	± 22	± 20	± 20	± 18	± 15	± 14
Decimal digits:	6.5	6.5	6	6	5.5	4.5	4

Noise Rejection (dB)

Noise Rejection Conditions: CMR measured with 1 k Ω in both HIGH and LOW leads with a 10% imbalance, LOW connected to COMMON at source, measured with respect to earth ground. NMR is for specified frequencies $\pm 0.1\%$.

dc Voltage & Resistance:

		320 ms	267 ms	20 ms	Aperture 16.7 ms	2.5 ms	100 μ s	10 μ s
dc:	Common mode rejection	150 dB	150 dB	150 dB	150 dB	150 dB	150 dB	150 dB
50 Hz:	Power line cycles (NPLCs)	16	—	1	—	—	—	—
	Normal mode (50 Hz) rejection	84 dB	0 dB	60 dB	0 dB	0 dB	0 dB	0 dB
60 Hz:	Power line cycles (NPLCs)	—	16	—	1	—	—	—
	Normal mode (60 Hz) rejection	0 dB	84 dB	0 dB	60 dB	0 dB	0 dB	0 dB
400 Hz:	Power line cycles (NPLCs)	128	—	8	—	1	—	—
	Normal mode (400 Hz) rejection	84 dB	0 dB	84 dB	0 dB	60 dB	0 dB	0 dB
ac Voltage:								
dc to 400 Hz:	Common mode rejection	110 dB	110 dB	110 dB	110 dB	110 dB	110 dB	110 dB

dc Voltage

Accuracy Conditions: Auto zero on, one hour warmup. Temperature within $\pm 5^\circ$ C of calibration temperature (module calibrated at 18-28 $^\circ$ C).

Range	Input Resistance	Resolution vs Aperture (Volts)		90-Day Accuracy vs Aperture ± (% of Reading + Volts)	
		20/16.7 ms	10 μs	20/16.7 ms	10 μs
125 mV	>100 MΩ	120 nV	7.6 μV	0.023% + 5 μV	0.115% + 60 μV
1 V	>100 MΩ	1.0 μV	61 μV	0.013% + 15 μV	0.1% + 200 μV
8 V	>100 MΩ	7.6 μV	488 μV	0.01% + 50 μV	0.1% + 1.5 mV
64 V	10 MΩ ± 5%	61 μV	3.9 mV	0.015% + 1 mV	0.1% + 20 mV
300 V	10 MΩ ± 5%	488 μV	31 mV	0.015% + 5 mV	0.1% + 80 mV
dc voltage:		300 V			
Voltage accuracy (dc):		0.0145%			

Four-Wire Resistance

Accuracy Conditions: Auto zero on, one hour warmup. Temperature within $\pm 5^\circ$ C of calibration temperature (module calibrated at 18-28 $^\circ$ C).

Range	Source Current	Maximum Open Circuit Voltage	Resolution vs Aperture (Ω)		90-Day Accuracy vs Aperture \pm (% of Reading + Ω)	
			20/16.7 ms	10 μ s	20/16.7 ms	10 μ s
256 Ω	488 μ A	11.5 V	250 $\mu\Omega$	15 m Ω	0.035% + 10 m Ω	0.12% + 50 m Ω
2 k Ω	488 μ A	11.5 V	2 m Ω	125 m Ω	0.025% + 20 m Ω	0.1% + 200 m Ω
16 k Ω	61 μ A	11.5 V	15 m Ω	1 Ω	0.025% + 200 m Ω	0.1% + 2 Ω
131 k Ω	61 μ A	11.5 V	125 m Ω	8 Ω	0.025% + 1 Ω	0.1% + 16 Ω
1 M Ω	7.6 μ A	11.5 V	1 Ω	64 Ω	0.015% + 10 Ω	0.1% + 120 Ω

Note: With offset compensation on, accuracy is the same as for the voltmeter alone.

2/4-wire Ω : 1 M Ω

(Agilent E1411B continued)

True RMS ac Voltage (ac coupled)

Crest Factor: 7 at 10% full scale; 1.5 at full scale. Accuracy Conditions: Sine wave inputs >10% of full scale. dc component <10% of ac component. Auto-zero on, 1 hour warmup. Temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

Range (RMS)	Input Impedance	Frequency	Resolution vs Aperture (Volts)		90-Day Accuracy vs Aperture \pm (% of Reading + Volts)	
			320/267 ms	10 μs	320/267 ms	All other apertures
87.5 mV	>100 M Ω , <100 pF	20-50 Hz	30 nV	7.6 μV	2.175% + 200 μV	2.175% + 1 mV
		50 Hz-1 kHz			0.675% + 200 μV	0.675% + 200 μV
		1-5 kHz			0.675% + 200 μV	0.675% + 200 μV
		5-10 kHz			3.175% + 200 μV	3.175% + 200 μV
700 mV	>100 M Ω , <100 pF	20-50 Hz	0.24 μV	61 μV	2.125% + 1.5 mV	2.125% + 8 mV
		50 Hz-1 kHz			0.625% + 1.5 mV	0.625% + 1.5 mV
		1-5 kHz			0.625% + 1.5 mV	0.625% + 1.5 mV
		5-10 kHz			3.125% + 1.5 mV	3.125% + 1.5 mV
5.6 V	>100 M Ω , <100 pF	20-50 Hz	2.0 μV	488 μV	2.125% + 15 mV	2.125% + 80 mV
		50 Hz-1 kHz			0.625% + 15 mV	0.625% + 15 mV
		1-5 kHz			1.125% + 15 mV	1.125% + 15 mV
		5-10 kHz			10.125% + 15 mV	10.125% + 15 mV
44.8 V	10 M $\Omega \pm 5\%$, <100 pF	20-50 Hz	15 μV	3.9 mV	2.125% + 100 mV	2.125% + 500 mV
		50 Hz-1 kHz			0.625% + 100 mV	0.625% + 100 mV
		1-5 kHz			1.125% + 100 mV	1.125% + 100 mV
		5-10 kHz			10.125% + 100 mV	10.125% + 100 mV
300 V	10 M $\Omega \pm 5\%$, <100 pF	20-50 Hz	122 μV	31 mV	2.125% + 500 mV	2.125% + 2.5 V
		50 Hz-1 kHz			0.625% + 500 mV	0.625% + 500 mV
		1-5 kHz			1.125% + 500 mV	1.125% + 500 mV
		5-10 kHz			10.125% + 500 mV	10.125% + 500 mV

ac voltage: 300 V
Voltage accuracy (ac): 0.84%

Timing/Synchronization

Timer/pacer:	
Timer range:	76 μs to 65.5 ms
Resolution:	2 μs
Programmable delay:	
Delay range:	40 μs to 16 s
Resolution:	2 μs
External trigger:	
Minimum pulse width:	100 ns
Maximum trigger rate:	5 kHz (Trigger Condition, negative edge; Fixed range, 10 μs aperture)

Isolation

450 Vpk between any terminal and chassis.

dc Voltage Accuracy with Relay Multiplexers

Range	20/16.7 ms	10 μs	20/16.7 ms	10 μs
125 mV	0.023% + 9 μV	0.115% + 64 μV	0.023% + 55 μV	0.115% + 110 μV
1 V	0.013% + 19 μV	0.1% + 204 μV	0.013% + 65 μV	0.1% + 250 μV
8 V	0.01% + 54 μV	0.1% + 1.5 mV	0.01% + 100 μV	0.1% + 1.55 mV
64 V	0.015% + 1 mV	0.1% + 20 mV	0.015% + 1.05 mV	0.1% + 20 mV
300 V	0.015% + 5 mV	0.1% + 80 mV	0.015% + 5.05 mV	0.1% + 80 mV

Accuracy Conditions: Auto zero on, one hour warmup. Temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18-28^\circ\text{C}$).

True RMS ac Voltage (ac coupled) with Relay Multiplexers

1-5 kHz and 5-10 kHz frequencies (all apertures) when using Relay Multiplexers (E1343A, E1345A, E1346A, or E1347A). Add 0.2% to the ac Voltage specifications.

Strain Measurements with Strain Relay Multiplexers

All measurements are made using the MEAS command.

Note: The Agilent E1406A command module and embedded controllers provide units conversion; if the E1411B is register programmed, your program must make the units conversion.

Vs = 5 V Power Supply / Gage Factor = 2

		18-20 $^\circ\text{C}$		Temp. Coefficient	
		μe	%e	μe	%e
Relays	Quarter	20.8	.023	1.96	0.006
	Half	2.92	.023	0.23	0.006
	Full	0.834	.023	0.053	0.006
FETs	Quarter	26.3	.023	3.98	0.006
	Half	5.63	.023	1.24	0.006
	Full	2.19	.023	0.557	0.006

Vs = 1 V Power Supply / Gage Factor = 2

		18-20 $^\circ\text{C}$		Temp. Coefficient	
		μe	%e	μe	%e
Relays	Quarter	25.8	0.023	1.96	0.006
	Half	5.39	0.023	0.23	0.006
	Full	2.07	0.023	0.053	0.006
FETs	Quarter	52.9	0.023	12.0	0.006
	Half	18.9	0.023	5.27	0.006
	Full	8.85	0.023	2.57	0.006

Vs = 0.1 V Power Supply / Gage Factor = 2

		18-20 $^\circ\text{C}$		Temp. Coefficient	
		μe	%e	μe	%e
Relays	Quarter	81.3	0.023	1.96	0.006
	Half	33.2	0.023	0.23	0.006
	Full	16	0.023	0.053	0.006
FETs	Quarter	353	0.023	103	0.006
	Half	169	0.023	50.7	0.006
	Full	83.8	0.023	25.3	0.006

(Agilent E1411B continued)

Temperature

The temperature accuracy graphs (below) include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS-90 standard transducer curves. Add your transducer accuracy to determine total measurement error.

Note: The E1406A command modules and Agilent embedded VXI controllers provide units conversion; if the E1411B is register-programmed, your program must make the necessary units conversion.

Four-Wire Resistance with Relay Multiplexers

Accuracy Conditions: Auto zero on, one hour warmup, temperature within $\pm 5^\circ\text{C}$ of calibration temperature (module calibrated at $18\text{--}28^\circ\text{C}$).

Note: With offset compensation on, accuracy is the same as for the voltmeter alone.

90-Day Accuracy vs Aperture
 $\pm (\% \text{ of reading} + \Omega)$

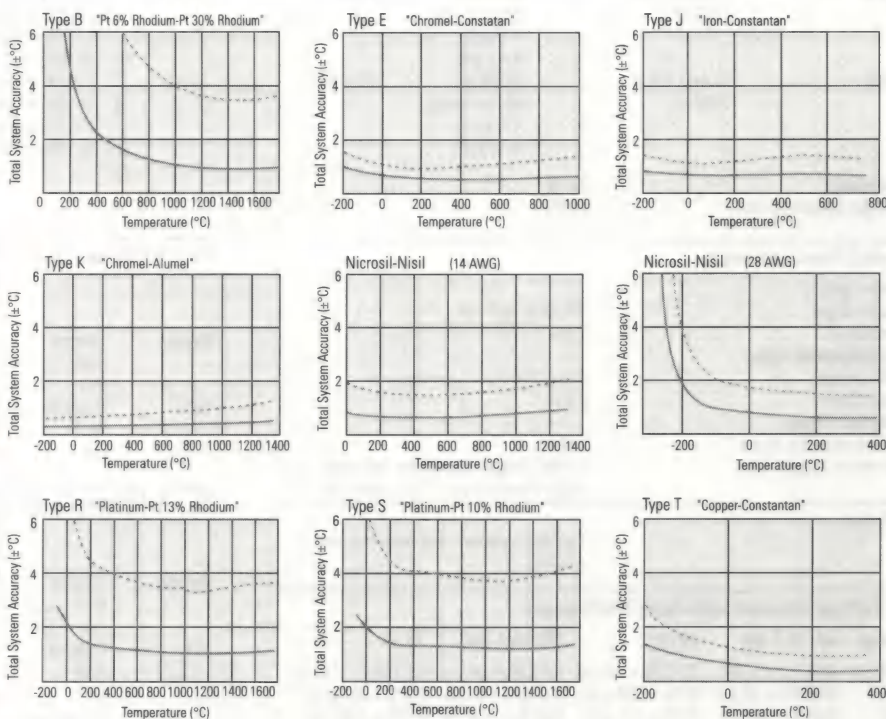
Range	E1326B & E1345A/47A 20/16.7 ms	10 μs
256 Ω	0.035% + 18.2 m Ω	0.12% + 58.2 m Ω
2 k Ω	0.025% + 28.2 m Ω	0.1% + 208 m Ω
16 k Ω	0.025% + 266 m Ω	0.1% + 2.1 Ω
131 k Ω	0.025% + 1.1 Ω	0.1% + 16.1 Ω
1 M Ω	0.025% + 10.5 Ω	0.1% + 121 Ω

Note: Accuracy data includes all errors contributed by the multimeter, analog bus ribbon cables, multiplexer, and transducer linearization (if applicable). The accuracies do not include transducer accuracy errors.

Thermocouple (E1411B Multimeters and E1347A/E1476A TC MUX):

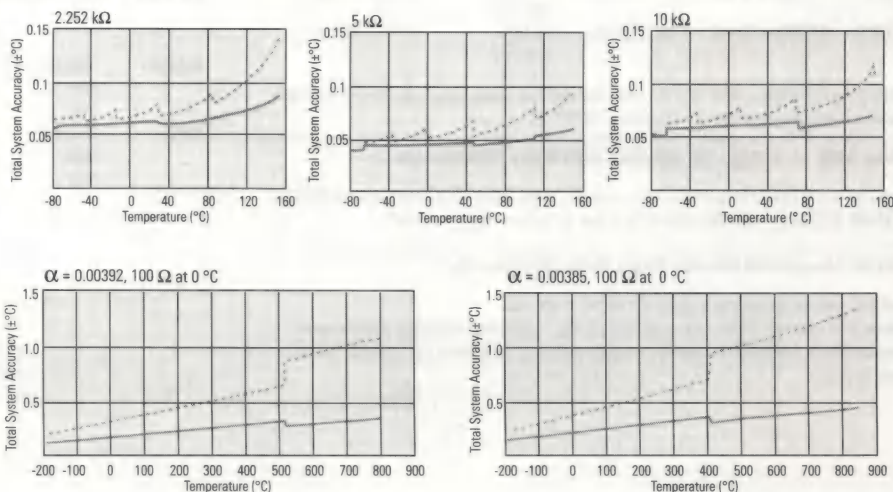
16 ms aperture (1 PLC):

100 μs aperture:

**Thermistors** (E1411B Multimeters and E1345A/E1347A/E1476A MUXs)**4-wire Ω :**

16 ms aperture (1 PLC):

100 μs aperture:

**RTDs** (E1411B Multimeters and E1345A/E1476A MUXs)**4-wire Ω :**

16 ms aperture (1 PLC):

100 μs aperture:

(Agilent E1411B continued)

Functions

Idc:	—
Iac:	—
Frequency:	—
Period:	—
Temp.:	Tm Tc RTD

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	Not specified
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	Yes, shared memory available with E1406A SCPI driver
VXI buses:	TTL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.02
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.55	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	8.50
ΔP mm H ₂ O:	0.14
Air Flow liter/s:	0.71

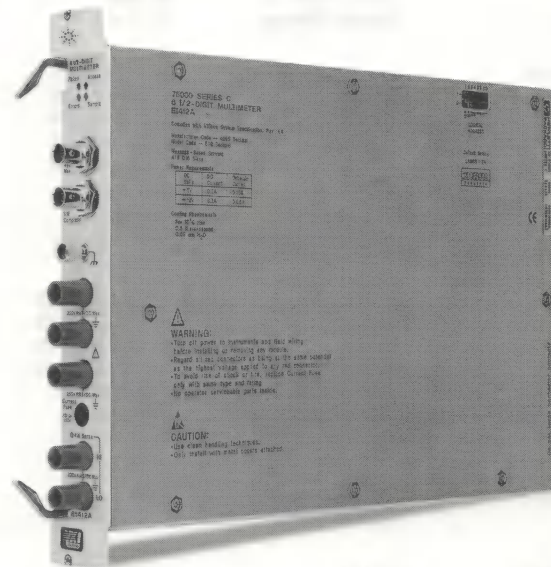
Ordering Information

Description	Product No.
5.5-Digit Multimeter, High-Accuracy, C-Size	E1411B
Service Manual	E1411B 0B3
Japan - Japanese Localization	E1411B ABJ
ANSI Z540 Compliant Calibration	E1411B A6J
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1411B W01

Publication No.: 5965-5562E

6.5-Digit High-Accuracy Multimeter, C-Size

Agilent E1412A



Agilent E1412A

- 1-Slot, C-size, message based
- DCV, ACV, DCI, ACI, 2/4-wire Ω , frequency, period
- NULL, MIN/MAX, LIMIT, dB, dBm
- 1000 reading/s into internal memory at 4.5 digits
- Fast range/function changes
- Reading storage with internal memory

Description

The Agilent Technologies E1412A 6.5-Digit Multimeter is a **C-size, 1-slot, message-based VXI module**. It is identical in electrical design to the E1312A, differing only in size. It delivers the widest functionality in Agilent's DMM line. It also delivers high performance and Agilent high quality at prices you'd expect to pay for a 5.5-digit DMM.

This multimeter's wide product functionality includes volts, amps, ohms, and frequency with advanced tests including limit checks to drive a TTL output and dc voltage ratios. Standard measurements include ac/dc voltage, ac/dc current, 2- and 4-wire Ω , plus frequency/period. When measuring dcV, this multimeter can deliver 65 range changes per second and 30 function changes per second.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

dc Specifications

Specifications are for 1-hour warm-up at an integration time of 100 PLCs.

dc Summary

dc voltage:	300 V max.
Voltage accuracy (dc):	$\pm 0.0019\%$

(Agilent E1412A continued)

dc Accuracy ± (% of reading + % of range):

Specifications are for 1-hour warm-up at 6.5 digits.

dc voltage:

Range ⁽²⁾	Test Current or Burden Voltage	24 Hour ⁽¹⁾ 23° C ± 1° C	90 Day 23° C ± 5° C	1 Year 23° C ± 5° C	Temperature Coefficient 0° C - 18° C 28° C - 55° C
100.0000 mV		0.0030 + 0.0030	0.0040 + 0.0035	0.0050 + 0.0035	0.0005 + 0.0005
1.000000 V		0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007	0.0005 + 0.0001
10.00000 V		0.0015 + 0.0004	0.0020 + 0.0005	0.0035 + 0.0005	0.0005 + 0.0001
100.0000 V		0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006	0.0005 + 0.0001
300.0000 V		0.0020 + 0.0018	0.0035 + 0.0030	0.0045 + 0.0030	0.0005 + 0.0003

Resistance ⁽³⁾ Range	Test Current or Burden Voltage	24 Hour ⁽¹⁾ 23° C ± 1° C	90 Day 23° C ± 5° C	1 Year 23° C ± 5° C	Temperature Coefficient 0° C - 18° C 28° C - 55° C
100.0000 Ω	1 mA	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	0.0006 + 0.0005
1.000000 kΩ	1 mA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
10.00000 kΩ	100 μA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
100.0000 kΩ	10 μA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
1.000000 MΩ	5 μA	0.002 + 0.001	0.008 + 0.001	0.010 + 0.001	0.0010 + 0.0002
10.00000 MΩ	500 nA	0.015 + 0.001	0.035 + 0.001	0.054 + 0.001	0.0030 + 0.0004
100.0000 MΩ	500 nA 10 MΩ	0.300 + 0.010	0.800 + 0.010	0.800 + 0.010	0.1500 + 0.0002

dc current: Range	Test Current or Burden Voltage	24 Hour 23° C ± 1° C	90 Day 23° C ± 5° C	1 Year 23° C ± 5° C	Temperature Coefficient 0° C - 18° C 28° C - 55° C
10.00000 mA	<0.1 V	0.005 + 0.010	0.050 + 0.020	0.070 + 0.020	0.005 + 0.0020
100.0000 mA	<0.6 V	0.01 + 0.004	0.040 + 0.005	0.070 + 0.005	0.006 + 0.0005
1.000000 A	<1 V	0.10 + 0.006	0.130 + 0.010	0.150 + 0.010	0.005 + 0.0010
3.000000 A	<2 V	0.70 + 0.020	0.720 + 0.020	0.720 + 0.020	0.005 + 0.0020

dc:dc Ratio:Range⁽²⁾

100 mV to 300 V:

(Input Accuracy) + (Reference Accuracy)

Input Accuracy = accuracy specification for the HI-LO input signal

Reference Accuracy = accuracy specification for HI-LO reference input signal

(1) Relative to calibration standards.

(2) 20% overrange on all ranges, except 300 Vdc and 3 A range.

(3) Specifications are for 4-wire Ω function, or 2-wire Ω using Math Null, Without Math Null, add 0.2 Ω additional error in 2-wire Ω function.

dc Voltage Characteristics**Measurement method:** Continuously integrating, multi-slope III A/D converter**A/D linearity:** 0.0002% of reading + 0.0001% of range**2/4-wire Ω:** 100 MΩ**Input resistance:** Selectable 10 MΩ or 10 GΩ

0.1 V, 1 V, 10 V ranges:

100 V, 300 V ranges: 10 MΩ ± 1%

Input bias current: <30 pA at 25° C**Input terminals:** Copper alloy**Input protection:** 300 V on all ranges**Resistance****Measurement method:** Selectable 4-wire or 2-wire Ω (Current source referenced to low input)**Max. lead resistance:** (4-wire Ω) 10% of range per lead for 100 Ω and 1 kΩ per lead on all other ranges**dc Current****Input protection:** 300 V on all ranges**Shunt resistor:** 0.1 Ω for 1 A and 3 A, 5 Ω for 10 mA and 100 mA**Input protection:** Externally accessible 3 A, 250 V fuse**Measurement Noise Rejection**

60 Hz (50 Hz) (For 1 kΩ unbalance in LO lead.)

dc CMMR: 140 dB**Integration Time** **Normal mode rejection⁽¹⁾**100 PLC/1.67s (2s) 60 dB⁽²⁾10 PLC/167 ms (200 ms) 60 dB⁽²⁾1 PLC/16.7 ms (20 ms) 60 dB⁽²⁾

<1 PLC/3 ms (800 μs) 0 dB

(1) For power-line frequency ± 0.1%.

(2) For power-line frequency ± 1%, subtract 20 dB; for ± 3%, subtract 30 dB.

System Speed

(Speeds are for 4.5 digits, Delay 0 and Autozero OFF. Includes measurement and data transfer over VXI backplane.)

Function change: 30/s**Range change:** 65/s**Autorange time:** <30 ms**Max. internal trigger rate:** 1000/s**Max. external trigger rate to memory:** 1000/s**dc:dc Ratio****Measurement method:** Input HI-LO/Reference HI-LO
Apply "Reference HI-LO" signal to Ohms 4-Wire Sense terminals."**Input HI to Input LO:** 100 mV to 300 V**Reference HI to Input LO:** <12 V on 100 mV to 10 V ranges (autoranged)**Reference LO to Input LO:** <2 V

(Agilent E1412A continued)

Additional Error with Autozero OFF

Following instrument warm-up at calibration temperature $\pm 1^\circ\text{C}$ and <10 minutes.

100mV-100V ranges:	add 0.0002% reading + $5\ \mu\text{V}$
300 V range:	add 0.0006% reading

dc Operating Characteristics

Readings speeds for 60 Hz and (50 Hz) operation, Autozero OFF.

Function	NPLC	Digits	Reading/s	Additional Noise Error
DCV, DCI and Ω	100	6.5	0.6 (0.5)	0% of range
DCV, DCI and Ω	10	6.5	6 (5)	0% of range
DCV, DCI and Ω	1	5.5	60 (50)	0.001% of range*
DCV, DCI and Ω	.2	5.5	300	0.001% of range*
DCV, DCI and Ω	.02	4.5	1,000	0.01% of range*

*For 300 V range: use 0.003% of range for 5.5 digits and 0.030% of range for 4.5 digits.
For all ranges: add 20 μV for dc Volts, 4 μA for dc current, or 20 m Ω for resistance.

ac Specifications**ac Summary**

ac voltage:	300 V max.
Voltage accuracy (ac):	$\pm 0.07\%$

ac Accuracy \pm (% of reading + % of range):

Specifications are for 1-hour warm-up at 6.5 digits.
Slow ac filter, sinewave input.

True RMS ac Voltage⁽³⁾:

Range ⁽²⁾	Frequency	24 Hour ⁽¹⁾ 23° C \pm 1° C	90 Day 23° C \pm 5° C	1 Year 23° C \pm 5° C	Temperature Coefficient 0° C - 18° C 28° C - 55° C
100.0000 mV	3 Hz-5 Hz	1.00 + 0.03	1.00 + 0.04	1.00 + 0.04	0.100 + 0.004
100.0000 mV	5 Hz-10 Hz	0.35 + 0.03	0.35 + 0.04	0.35 + 0.04	0.035 + 0.004
100.0000 mV	10 Hz-20 kHz	0.04 + 0.03	0.05 + 0.04	0.06 + 0.04	0.005 + 0.004
100.0000 mV	20 kHz-50 kHz	0.10 + 0.05	0.11 + 0.05	0.12 + 0.05	0.011 + 0.005
100.0000 mV	50 kHz-100 kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
100.0000 mV	100 kHz-300 kHz	5.00 + 0.50	5.00 + 0.50	5.00 + 0.50	0.020 + 0.020
1.000000 V to 300.000 V ⁽⁴⁾	3 Hz-5 Hz	1.00 + 0.02	1.00 + 0.03	1.00 + 0.03	0.100 + 0.003
1.000000 V to 300.000 V ⁽⁴⁾	5 Hz-10 Hz	0.35 + 0.02	0.35 + 0.03	0.35 + 0.03	0.035 + 0.003
1.000000 V to 300.000 V ⁽⁴⁾	10 Hz-20 kHz	0.04 + 0.02	0.05 + 0.03	0.06 + 0.03	0.005 + 0.003
1.000000 V to 300.000 V ⁽⁴⁾	20 kHz-50 kHz	0.10 + 0.04	0.11 + 0.05	0.12 + 0.05	0.011 + 0.005
1.000000 V to 300.000 V ⁽⁴⁾	50 kHz-100 kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008
1.000000 V to 300.000 V ⁽⁴⁾	100 kHz-300 kHz ⁽⁵⁾	5.00 + 0.50	5.00 + 0.50	5.00 + 0.50	0.200 + 0.020

True RMS ac Current⁽³⁾:

Range	Frequency	24 Hour 23° C \pm 1° C	90 Day 23° C \pm 5° C	1 Year 23° C \pm 5° C	Temperature Coefficient 0° C - 18° C 28° C - 55° C
1.000000 A	3 Hz-5 Hz	1.05 + 0.04	1.05 + 0.04	1.05 + 0.04	0.100 + 0.006
1.000000 A	5 Hz-10 Hz	0.35 + 0.04	0.35 + 0.04	0.35 + 0.04	0.035 + 0.006
1.000000 A	10 Hz-1 kHz	0.15 + 0.04	0.15 + 0.04	0.15 + 0.04	0.015 + 0.006
1.000000 A	1 kHz-50 kHz	0.40 + 0.04	0.40 + 0.04	0.40 + 0.04	0.015 + 0.006
3.000000 A	3 Hz-5 Hz	1.70 + 0.06	1.70 + 0.06	1.70 + 0.06	0.100 + 0.006
3.000000 A	5 Hz-10 Hz	0.95 + 0.06	0.95 + 0.06	0.95 + 0.06	0.035 + 0.006
3.000000 A	10 Hz-1 kHz	0.75 + 0.06	0.75 + 0.06	0.75 + 0.06	0.015 + 0.006
3.000000 A	1 kHz-50 kHz	1.00 + 0.06	1.00 + 0.06	1.00 + 0.06	0.15 + 0.06

(1) Relative to calibration standards.

(2) 20% overrange on all ranges, except 300 Vac and 3A ranges which have 1% overrange.

(3) 100 mV to 100 V range specifications are for sine wave input $>5\%$ of range. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range additional error. For 50 kHz to 100 kHz, add 0.13% additional error. 300 V range specifications are for sinewave input $>15\%$ of range. For inputs from 3% to 15% of range and >50 kHz, add 0.30% of kHz, add 0.40% of range additional error.

(4) For 300 V range, use (% reading) shown in table and multiply each (% range) $\times 3$.

(5) 300 Vac range limited to 50 kHz. For frequencies >50 kHz, signals must be $\leq 1.5 \times 10^7$ V/Hz.

Considerations**Settling considerations:**

Reading settling times are affected by source impedance, cable dielectric characteristics, and input signal changes.

Measurement considerations:

Agilent recommends the use of Teflon or other high impedance, low-dielectric absorption wire insulation for these measurements.

(Agilent E1412A continued)

Additional ac Specifications:

Frequency	Low Freq. Errors (% of reading)			Crest Factor Errors (non-sinewave)*	
	Slow	ac Filter Medium	Fast	Crest Factor	Error (% of reading)
10 Hz-20 Hz	0	0.74	—	1-2	0.05%
20 Hz-40 Hz	0	0.22	—	2-3	0.15%
40 Hz-100 Hz	0	0.06	0.73	3-4	0.30%
100 Hz-200 Hz	0	0.01	0.22	4-5	0.40%
200 Hz-1 kHz	0	0	0.18		
>1 kHz	0	0	0		

*For frequencies below 100 Hz, slow ac filter specified for sinewave input only.

Noise Rejection

(For 1 k Ω unbalance in LO lead.)

ac CMMR: 70 dB

True RMS ac Voltage

Measurement method: ac-coupled True RMS — measures the ac component of the input with up to 300 Vdc of bias on any range.
(Max ac+dc = 300 V rms.)
Maximum 5:1 at full scale

Crest factor:**ac filter bandwidth:**

Slow:

Medium:

Fast:

Input impedance:**Input protection:**

3 Hz-300 kHz

20 Hz-300 kHz

200 Hz-300 kHz

1 M Ω \pm 2%, in parallel with 100 pF

300 Vrms all ranges

True RMS ac Current**Measurement method:**

Direct couple to the fuse and shunt.
ac-coupled True RMS measurement
(measures the ac component only).
0.1 Ω for 1 A and 3 A ranges

Shunt resistor:**Burden voltage:**

1A range:

3A range:

Input protection:

<1 Vrms

<2 Vrms

Externally accessible 3 A, 250 V fuse

ac Operating Characteristics

Maximum reading rates 0.01% of ac step additional error. Additional settling delay required when input dc level varies.

Function	Digits	Reading/s	ac Filter
ACV and ACI	6.5	7 s/reading	Slow
ACV and ACI	6.5	1	Medium
ACV and ACI	6.5	1.6 ⁽¹⁾	Fast
ACV and ACI	6.5	10	Fast
ACV and ACI	6.5	50 ⁽²⁾	Fast

(1) For External Trigger or remote operation using default settling delay (Delay Auto).

(2) Maximum useful limit with default settling delays used.

Systems Speeds

Maximum useful limit with default settling delays used; Speeds are for 4.5 digits, Delay 0, and Fast ac filter.

Function or range change:	5/s
Autorange time:	<0.8 s
ASCII reading to GPIB:	50/sec
Max. internal trigger rate:	50/s
Max. external trigger rate to memory:	50/s

Frequency and Period Specifications**Frequency and Period Accuracy (% of reading)**

Function	Range ⁽²⁾	Frequency	24 Hour ⁽¹⁾ 23° C \pm 1° C	90 Day 23° C \pm 5° C	1 Year 23° C \pm 5° C	Temperature Coefficient 0° C - 18° C 28° C - 55° C
Specifications are for 1-hour warm-up at 6.5 digits.						
Frequency, Period	100 mV to 300 V	3 Hz-5 Hz	0.10	0.10	0.10	0.005
Frequency, Period	100 mV to 300 V	5 Hz-10 Hz	0.05	0.05	0.06	0.005
Frequency, Period	100 mV to 300 V	10 Hz-40 Hz	0.03	0.03	0.03	0.001
Frequency, Period	100 mV to 300 V	40 Hz-300 kHz	0.006	0.01	0.01	0.001

(1) Relative to calibration standards.

(2) 20% overrange on all ranges, except 300 Vac range which has 1% overrange.

Additional Low-Frequency Errors (% of reading)

Input >100 mV. For mV input, multiply % of reading error x 10.

Frequency	6.5 digits	5.5 digits	4.5 digits
3 Hz-5 Hz	0	0.12	0.12
5 Hz-10 Hz	0	0.17	0.17
10 Hz-40 Hz	0	0.2	0.2
40 Hz-100 Hz	0	0.06	0.21
100 Hz-300 Hz	0	0.03	0.21
300 Hz-1 kHz	0	0.01	0.07
>1 kHz	0	0	0.02

Operating Characteristics

Speeds are for 4.5 digits, Delay 0, and Fast ac filter.

Function	Digits	Reading/s
Frequency, Period	6.5	1
Frequency, Period	5.5	9.8
Frequency, Period	4.5	80

Systems Speeds

Configuration rates:	14/s
Autorange time:	<0.6 s
Max. internal trigger rate:	80/s
Max. external trigger rate to memory:	80/s

Characteristics

Warmup time:	1 hour
State storage memory:	Power-off state automatically saved

Measuring Characteristics**Measurement method:**

Reciprocal-counting technique. ac-coupled input using the ac voltage measurement function.

Voltage ranges:

100 mV rms full scale to 300 V rms.
Auto or manual ranges.

Gate time:

10 ms, 100 ms, or 1 s

Settling considerations:

Errors will occur when attempting to measure the frequency or period of an input following a dc offset voltage change. The input blocking RC time constant must be allowed to fully settle (up to 1 s) before the most accurate measurements are possible. All frequency counters are susceptible to error when measuring low-voltage, low-frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors.

Measurement considerations:**Max. reading rate:**

1K

Functions

Idc:	3 A
Iac:	3 A
Frequency:	300 kHz
Period:	3.3 μ s
Temp.:	Tm, Tc, RTD

(Agilent E1412A continued)

General Specifications

VXI Characteristics

VXI device type:	Message based
Data transfer bus:	A16
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	n/a

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	No
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.2	0.1
+12 V:	0.7	0.06
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	9.40
ΔP mm H ₂ O:	0.05
Air Flow liter/s:	0.80

Ordering Information

Description	Product No.
6.5-Digit Multimeter, High Accuracy	E1412A
ANSI Z540 Compliant Calibration	E1412A A6J
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E1412A W01

Publication No.: 5965-5563E

Power Meter

Agilent E1416A



Agilent E1416A

- 1-Slot, C-size, message based
- Single channel
- ± 0.02 dB or $\pm 0.5\%$ instrumentation accuracy
- 100 kHz to 110 GHz, sensor dependent
- -70 to +44 dBm
- 1 mW power reference

Description

The Agilent Technologies E1416A Power Meter is a C-size, 1-slot, message-based VXI module. It is a high-performance, single-channel, programmable, average power meter compatible with the Agilent 8480 family of thermocouple and diode power sensors.

This power meter makes accurate and reliable average power measurements. With its powerful programming capability, exceptional accuracy and reliability, it lets you measure your test signal with speed, precision, and confidence!

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Characteristics

Frequency:	Allows entry of test signal frequency for cal factor selection
Offset:	Allows measurement to be offset by ± 99.99 dB
Resolution:	Selection of 0.1, 0.01, and 0.001 dB. Auto Filter Mode automatically selects the required number of averages for the chosen range and resolution
Averaging:	Selectable from 1 to 1024 readings (<i>in powers of 2</i>)
Duty cycle:	Displays peak power representation of measured RMS power for rectangular pulses
Sensor tables:	Allows entry and storage of up to 10 sensor cal factor tables versus frequency
Save/recall states:	Saves and recalls 10 complete E1416A operating states

(Agilent E1416A continued)

General

Frequency:	100 kHz to 110 GHz sensor dependent
Power range:	-70 to +44 dBm (100 pW to 25 W), sensor dependent
Dynamic range:	50 dB in 10 dB ranges
Results units:	W, dBm (<i>absolute</i>), %, dB <i>relative</i>
Accuracy:	± 0.02 dB or ± 0.5% (instrument, absolute mode). In ranges of 4 or 5, add sensor linearity percentage
Zero set:	± 0.5% of full scale on most sensitive range. Divide by 10 for each higher range, ± 1 count
Power reference:	1.00 mW (50 MHz oscillator factory set to ± 0.7% traceable to NIST)

Functions

Power:	Yes
Offset:	Yes
Averaging:	Yes
Duty cycle:	Yes

General Specifications

VXI Characteristics

VXI device type:	Message based
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	n/a

Instrument Drivers - See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I _{PM}	I _{DM}
+5 V:	1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0.1	0.01
-24 V:	0.1	0.01
-5.2 V:	0	0
-2 V:	0	0

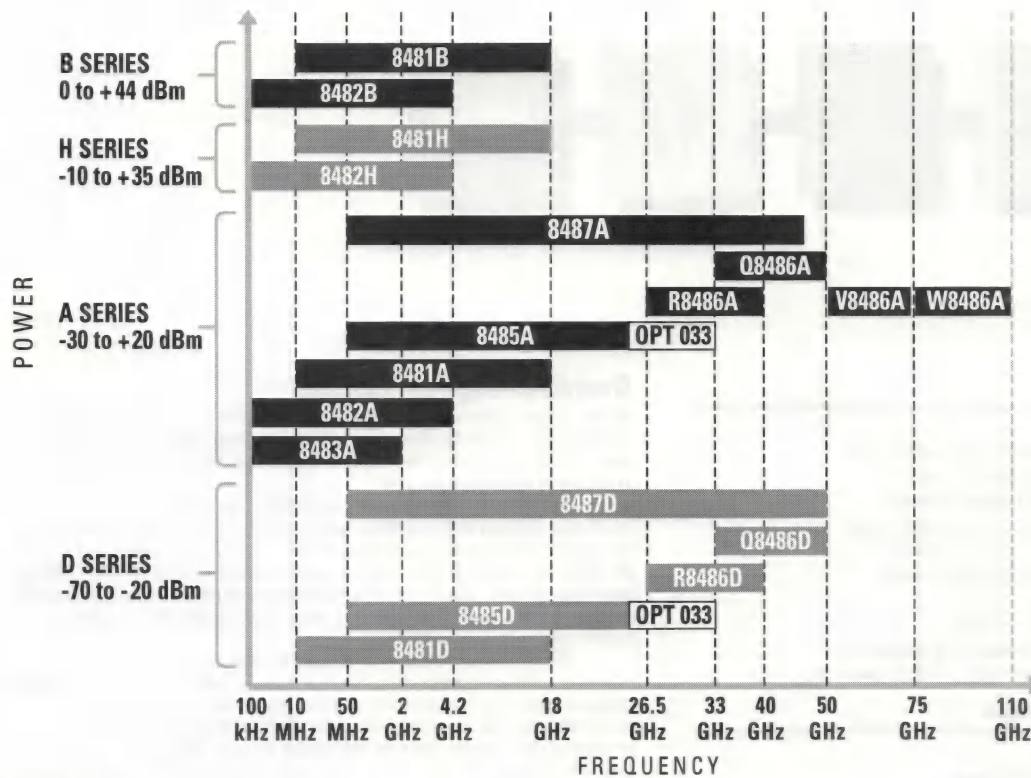
Cooling/Slot

Watts/slot:	12.20
ΔP mm H ₂ O:	1.00
Air Flow liter/s:	0.20

Ordering Information

Description	Product No.
Power Meter, C-Size VXI	E1416A
Delete Cable	E1416A 004
Service Support Kit	E1416A 915
Additional User Manual	E1416A 916
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1416A W01
5-ft (1.5 m) Power Sensor Cable	11730A
10-ft (3.0 m) Power Sensor Cable	11730B
20-ft (6.1 m) Power Sensor Cable	11730C
50-ft (15.2 m) Power Sensor Cable	11730D
100-ft (30.5 m) Power Sensor Cable	11730E
200-ft (61.0 m) Power Sensor Cable	11730F
High-power Thermocouple Power Sensor	8481B
Mil Std 45662A Calibration Certification	8481B 1BN
Extra Manual Set	8481B 910
High-power Sensor, 100 kHz to 4.2 GHz	8482B
Mil Std 45662A Calibration Certification	8482B 1BN
3-watt Power Sensor, 10 MHz to 18 GHz	8481H
Mil Std 45662A Calibration Certification	8481H 1BN
Extra Manual Set	8481H 910
3-watt Power Sensor, 100 kHz to 4.2 GHz	8482H
Mil Std 45662A Calibration Certification	8482H 1BN
Extra Manual Set	8482H 910
Power Sensor, 50 MHz to 26.5 GHz	8485A
Specified Performance for 0.05-33 GHz	8485A 033
Mil Std 45662A Calibration Certification	8485A 1BN
Extra Manual Set	8485A 910
Power Sensor, 10 MHz to 18 GHz	8481A
APC-7 Connector	8481A 001
Japanese Operating Manual	8481A 030
Mil Std 45662A Calibration Certification	8481A 1BN
Extra Manual Set	8481A 910
Power Sensor, 100 kHz to 4.2 GHz	8482A
Japanese Operating Manual	8482A 030
Mil Std 45662A Calibration Certification	8482A 1BN
Extra Manual Set	8482A 910
75-ohm Power Sensor, 100 kHz to 2 GHz	8483A
Japanese Operating Manual	8483A 030
Mil Std 45662A Calibration Certification	8483A 1BN
Extra Manual Set	8483A 910
Power Sensor, 26.5-40 GHz	R8486A
Power Sensor, 33-50 GHz	Q8486A
Power Sensor, 50 MHz to 50 GHz	8487A
V-band Power Sensor, 50 GHz to 75 GHz	V8486A
W-band Power Sensor	W8486A
Diode Power Sensor, 10 MHz to 18 GHz	8481D
Mil Std 45662A Calibration Certification	8481D 1BN
Extra Manual	8481D 910
High-sensitivity Diode Power Sensor	8485D
Specified Performance for 0.05-33 GHz	8485D 033
Mil Std 45662A Calibration Certification	8485D 1BN
Extra Manual	8485D 910
Diode Power Sensor, 50 MHz to 50 GHz	8487D
Waveguide Power Sensor, 26.5-40 GHz	R8486D
Waveguide Power Sensor, 33-50 GHz	Q8486D

(Agilent E1416A continued)



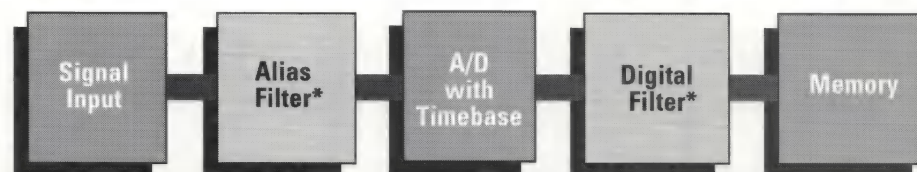
The E1416A is functionally equivalent to the Agilent 437B⁽¹⁾ or 70100A. It is compatible with all 8480 series sensors (and 11722A) as shown here.

⁽¹⁾The Agilent 437B has been obsoleted and replaced by the E4418B.

Publication No.: 5965-5564E

Overview

Digitizer Block Diagram



C-Size Digitizer Modules

Product No.	Description
E1430A	10 MSa/s Digitizer with Filters and Memory
E1432A	16-Channel 51.2 kSa/s Digitizer plus DSP
E1433B	8-Channel 196 kSa/s Digitizer plus DSP
E1437A	20 MSa/s Digitizer with Filters and Memory
E1438A	100 MSa/s ADC with Filters and Memory
E1439A	95 MSa/s Digitizer with 70 MHz IF Input
E1563A	800 kSa/s, 2-Channel Digitizer
E1564A	800 kSa/s, 4-Channel Digitizer
E3242A	4-Channel Charge/Voltage/ICP Breakout Box
E3243A	4-Channel Microphone/Voltage/ICP Breakout Box

C-Size Signal Analyzer and Signal Processor

Product No.	Description
89600A	Vector Signal Analyzer System
SCMVX008	Digital Signal Processor (Distributed Product)

C-Size Oscilloscope

Product No.	Description
E1428A	1 GSa/s VXI Oscilloscope

Introduction

High-speed digitizers help you capture all the significant electrical parameters (i.e., amplitudes and frequency components) of an input waveform. Waveform digitizers capture a wide variety of dynamic signals for digital processing of the signal. This processing occurs sometimes in a host computer, sometimes in discrete DSP modules, and sometimes in the digitizer itself. This last approach allows a much more detailed analysis of the waveform than is possible using other instruments – for example, a spectrum analyzer.

Digitizers are most often used for fast transient signals, IF/baseband signals, or noise and vibration signals. Agilent Technologies' digitizers combine several functions – signal conditioning, triggering, A/D conversion, data storage, and processing – in a single module.

Timing measurements are an important part of most test systems, so Agilent offers high-performance oscilloscope capability on a card. Oscilloscopes digitize analog signals and display significant waveshape and timing details of the test signal. Oscilloscopes digitize dynamic (i.e., rapidly changing) analog signals. In fact, the heart of an oscilloscope is an 8-bit high-speed digitizer, allowing visual interpretation of fast transients and high-frequency waveforms.

Overview: Digitizer Choices

Agilent offers digitizers to combine several functions into single modules. The E1563A and E1564A Digitizers, both 800 kSa/s with two and four channels respectively, are ideal for measurements in electromechanical design verification and electronic test.

The E1438A 100 MSa/s ADC with Filters and Memory is a high-resolution digitizer that provides clean, low-distortion samples and high-resolution digitizing. Its companion product, the E1439A, samples at 95 MSa/s and has a 70 MHz IF input, perfect for interfacing to VHF/UHF and microwave tuners. Both have built-in signal conditioning, anti-alias filtering, programmable bandwidth, and zoom capability, so they don't require additional external components.

The E1437A 20 MSa/s, 23-bit ADC is an ultra-linear digitizer that allows users to accurately characterize signals in both the time and frequency domains with very high resolution. Time-domain measurements (i.e., waveform capture) are done with up to 18 effective bits of amplitude resolution and nanosecond time resolution. Frequency-domain measurements are made with up to 110 dBfs of spurious-free dynamic range. The E1430A Digitizer, a 10 MSa/s version of the E1437A, is a more affordable solution for those applications requiring no more than a 4 MHz bandwidth.

The E1433B 8-Channel Digitizer plus DSP module includes transducer signal conditioning, anti-alias filters, digitization, and high-speed measurement computation. By integrating this functionality into a single module, the E1433B simplifies making accurate, high-speed measurements. Additionally, E3242A and E3243A Breakout Boxes are designed specifically to interface accelerometers and microphones to Agilent's high-performance digitizer modules – the E1432A and E1433B.

Overview: Signal Analyzer and Signal Processor Choices

In addition to digitizers, Agilent offers the 89600 Series Vector Signal Analyzer to help you evaluate and analyze leading-edge RF communication signals. This PC-based VXI system offers a dc to 2700 MHz frequency range, and spectrum, modulation and time domain analysis with 36 MHz information bandwidth, all controlled by a Windows NT or Windows 2000 graphical user interface.

Agilent also offers the TI-based SCMVX008 VXI DSP, which features two Texas Instruments TMS320C40 DSPs, and is ideal for application in communications, signal analysis, process control, data acquisition, and test.

Overview: The Agilent Oscilloscope Choice

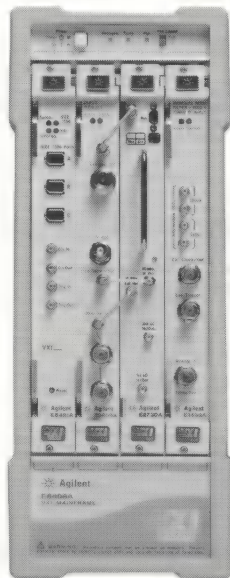
Agilent offers the E1428A oscilloscope to make your analog and timing measurements. For fast capture of many waveforms, the E1428A offers sequential single-shot mode and memory that can be optimized for acquisition and speed. This scope comes with a SCPI command set, as well as an Agilent 54510A-compatible command set.

Family Specifications

Model	E1430A	E1432A	E1433B	E1437A	E1438A	E1439A	E1563A	E1564A
	10 MSa/s Digitizer with Filters and Memory	16-Channel 51.2 kSa/s Digitizer with DSP	8-Channel 196 kSa/s Digitizer	20 MSa/s Digitizer with Filters and Memory	100 MSa/s ADC with Filters and Memory	95 MSa/s ADC with Filters, Memory, and 70 MHz IF Input	800 kSa/s, 2-Channel Digitizer	800 kSa/s, 4-Channel Digitizer
VXI Characteristics								
Size:	C	C	C	C	C	C	C	C
Slots:	1	1	1	1	1	1	1	1
VXI device type:	Register based	Register based	Register based	Message/ Register based	Register based	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.								
VXIplug&play Win Framework:	No	No	No	Yes	No	n/a	No	No
VXIplug&play Win 95/NT Framework:	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VXIplug&play HP-UX Framework:	No	Yes	Yes	Yes	No	Yes	No	No
Specifications								
Number of channels:	1	16	8	1	1	1	2	4
Bandwidth:	4 MHz	23 kHz	88 kHz	8 MHz	40 MHz	36 MHz	1 MHz	1 MHz
Resolution:	23 bits	16 bits	16 bits	23 bits	12 bits	12 bits	14 bits (incl. sign)	14 bits (incl. sign)
Sample rates:	10 MSa/s or 10.24 MSa/s	25.6 Hz to 51.2 kHz	1 Sa/s to 196 kSa/s	20 MSa/s or 20.48 MSa/s	100 or 102.4 MSa/s	95 MSa/s	1 Sa/s to 800 kSa/s	1 Sa/s to 800 kSa/s
Built-in DSP:	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Alias protection:	Anti-aliasing filter (switchable)	Anti-aliasing filter built-in	Anti-aliasing filter built-in	Anti-aliasing filter (switchable)	Anti-aliasing filter (switchable)	Anti-aliasing filter (switchable)	Oversample	Oversample
Basic accuracy:	± 0.03 dB	0.7%	0.5%	± 0.03 dB	± 0.7 dB	± 0.7 dB	0.1%	0.1%
Time base resolution:	100 ns	20 µs	5 µs	50 ns	10 ns	10.53 ns	0.1 µs	0.1 µs
Low-frequency CMR:	70 dB at 1 Vcom	50 dB	70 dB	70 dB at 1 Vcom	n/a	n/a	113 dB	113 dB
Variable bandwidth:	Yes	Yes	Yes	Yes	Yes	Yes	25 kHz switchable	4 ranges selectable
Trigger:	Next Sample	Next Sample	Next Sample	Next Sample	Next Sample	Next Sample	Time & Event	Time & Event
Pre-arm capture:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Memory:	8 MB FIFO	4 to 32 MB	32 MB	8 to 64 MB	18 to 288 MB	18 to 288 MB	4 to 64 MB	4 to 64 MB
Dual-ported memory:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Vector Signal Analyzer

Agilent 89600 Series



Agilent 89600 VSA

- 4-Slot, C-size, including IEEE-1394 interface
- Complete VSA instrument
- Windows NT or Windows 2000 software
- 2.7 GHz frequency range
- 36 MHz bandwidth RF; 39 MHz bandwidth baseband
- Tight links to ADS speed 3G design

Description

The Agilent Technologies 89600 VSA is a C-size, 3- or 4-slot measurement instrument, used as a comprehensive time-, frequency- and modulation-domain tool for designers of RF/wireless communication devices and systems. VSAs are now common tools in digital communications R&D because they allow designers to uncover problems they couldn't see using traditional spectrum analyzers. In addition to spectrum (ACP, spurious, etc.) and time domain analysis, they provide analog and digital demodulation, TDMA burst analysis, CDMA power statistics and flexible analysis for system troubleshooting of RF and DSP problems throughout the radio.

This new VSA covers wideband signals with bandwidths up to 36 MHz (RF) or 39 MHz (baseband). It also includes tight integration with PC-based applications and design tools. The product is typically composed of a compact VXI mainframe containing 4 modules, plus measurement software running on an external Windows NT or Windows 2000 personal computer.

Measurement bandwidth. One or two fast (95 MSamples/sec.) digitizers are used to analyze bandwidth of up to 36 MHz at RF and 39 MHz at baseband. Full-bandwidth time capture memory of up to 192 MSamples opens up new applications. The ability to re-analyze (zoom/change span and re-center) signals after capture makes the deeper memory useful for narrowband applications as well.

Intuitive, industry-standard user interface. Since the measurement software runs on a PC in Windows NT or Windows 2000, important functions are controlled graphically using well-known techniques. Help functions are comprehensive and easy to access. Multiple windows, configurable toolbars and built-in VBScript macro language make it easy to simplify and speed measurement setup with tools that you are already using.

Tight integration with PC-based design/analysis tools. Full connectivity with tools from EEsof/ADS to MATLAB to Excel and PowerPoint is finally here. Data portability is achieved with the ability to import/export in common formats and use standard Windows cut/paste functions. You can grab data from an ADS simulation and analyze it with a real vector signal analyzer. You can feed actual analyzer data into a simulation in ADS or MATLAB. You can 'Cut' a measurement from the 89600 and 'Paste' it into an Excel spreadsheet and create a graph/trace of your own. You can download calibrated time-capture data directly into any analysis tool you choose.

A complete VSA in EEsof ADS. You can purchase the VSA software without hardware and have a true vector signal analyzer measurement block to use INSIDE your ADS simulations. No need to worry about disagreement between your simulation tools and eventual hardware measurements. Now you can use the same user interface and proven algorithms in both domains.

Product Specifications

Specifications

Analyzer modes: Scalar, Vector, Time Capture, Analog Demod, Digital Demod

Frequency range:

89640A: dc to 2700 MHz

89610A: dc to 40 MHz

Sweep: Continuous and single sweep

Triggering: Free run, External, and IF triggering

Averaging: Scalar and Vector, rms, and rms exponential

Res. bandwidth:

Scalar: 1, 3, 10, arbitrary

Vector: 1, 3, 10, arbitrary

Ordering Information

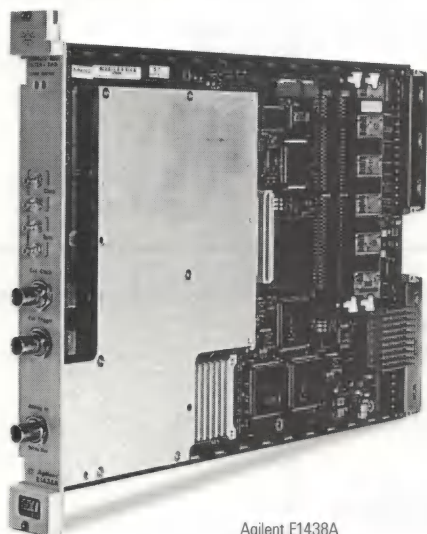
Description	Product No.
DC to 40 MHz Vector Signal Analyzer	89610A
Add 2nd DC to 40 MHz Input Channel	89610A 102
Dynamic Link to EEsof/ADS	89610A 105
Increase Capture Memory to 144 MB	89610A 144
Add 2nd DC to 40 MHz Input Channel – 144 MB	89610A 145
Increase Capture Memory to 288 MB	89610A 288
Add 2nd DC to 40 MHz Input Channel – 288 MB	89610A 289
Vector Modulation Analysis	89610A AYA
WCDMA and cdma2000 Modulation Analysis	89610A B7N
DC to 2.7 GHz Vector Signal Analyzer	89640A
Dynamic Link to EEsof/ADS	89640A 105
Increase Capture Memory to 144 MB	89640A 144
Increase Capture Memory to 288 MB	89640A 288
Vector Modulation Analysis	89640A AYA
WCDMA and cdma2000 Modulation Analysis	89640A B7N

Note: The 89610A and 89640A VSA come with a complete VXI system, including mainframe, IEEE-1394 (FireWire) interface and software that runs on any Windows NT or Windows 2000 PC (not included).

Publication No.: 5968-9349E

100 MSa/s ADC with Filters and Memory

Agilent E1438A



Agilent E1438A

- dc – 40 MHz input
- –90 dBfs residual spurious free dynamic range
- Anti-alias filter and signal conditioning
- Center frequency tunable digital decimation filters
- 18 MB RAM FIFO memory (288 MB available)
- Multi-channel ready

Description

The Agilent Technologies E1438A 100 MSa/s ADC with filters and memory is a C-size, 1-slot, register-based VXI module that provides you high-resolution digitizing at a faster sample rate than ever before from Agilent Technologies. Along with –90 dBfs spurious free dynamic range and 100 MSa/sec digitizing, it features full input signal conditioning, tunable digital filtering, a large signal capture memory, and high-speed data ports.

Full input signal conditioning matches the E1438A operating range to your signal and protects the digitizer from harmful over-voltages. ac/dc coupling and attenuation are standard. A 40 MHz anti-alias filter supports data-efficient Nyquist sampling.

Use the real-time digital filters to enhance signal to noise ratio and select specific signals for analysis. Capture signals in the 18 MB FIFO memory (144 MB and 288 MB optional). This memory also assembles the output data stream into data blocks, the format most DSP algorithms prefer.

Use the trigger, external clock and synchronization features for phase coherent sampling using multiple E1438A's. Multiple high-speed data output formats are provided including real and I&Q formats.

The E1438A is fully VXI *plug&play* compliant.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

A New Digitizer

The heart of the E1438A is a new, Agilent-designed, 100 MSa/s digitizer. This high-performance monolithic component provides clean, low distortion samples at a higher sample rate than ever before offered by Agilent Technologies.

Signal analysis algorithms produce better results when supplied with precise samples. The output precision of algorithms like RMS averaging, the Fast Fourier Transform, and various curve fitting algorithms is limited by spurs and distortion in the data. The E1438A reduces these contaminants, giving you more precise results.

Sample linearity and purity are the key and the E1438A provides the answer. Spurious signal contamination is at least –90 dBfs (below full scale). Harmonic distortion is down –65 dBc and noise density is –133 dBfs/Hz.

Built-in Digital Filtering and LO

The standard E1438A includes digital decimation filtering and a programmable LO. Use the real-time filters to reduce noise and improve signal to noise ratio or to filter out unwanted signals. The 16 filters provided reduce the analysis bandwidth of the E1438A from 40 MHz to 610 Hz in octave steps.

These filters also improve data efficiency. The data from each filter is decimated to reduce data rate and quantity without losing any signal information.

Included in the filter section is a digital LO. Use this complex frequency shifter to tune the center frequency of any digital filter anywhere in the 40 MHz input bandwidth of the E1438A.

The LO is a big help when you have to process digital modulation formats. The LO action is implemented using quadrature mixing, which produces the I/Q data needed for this task. These digital I and Q results are better matched and have lower spurious content, less than –90 dBfs, than I/Q signals produced by analog means. And, the LO's 0.001 Hz resolution is vital for the precise tuning needed to stop a rotating constellation diagram.

Analog Signal Conditioning Includes Alias Protection

The E1438A comes with analog signal conditioning, including a bypassable 40 MHz anti-alias filter. The anti-alias filter ensures the Nyquist-compatible sampling needed by most signal processing algorithms. The signal conditioning makes it easy to match the E1438A operating point to your signal amplitude and protects the digitizer from harmful voltages. Input bandwidth without alias protection is 100 MHz (typical).

Flexible Triggering and Synchronization

Select one of several ways to trigger the E1438A. Use *immediate* to begin sampling automatically. Select the *external* trigger mode when sampling must start coincident with an external event. Use the level mode to trigger on the level of the input signal itself. A *software* trigger command is also provided.

Large pre- and post-trigger delays (>36 MSamples with the memory option) are standard and the external trigger modes support slope selection.

Use the external synchronization and external clock features of the E1438A when your application requires closely coordinated sampling with multiple E1438As. Simply connect the ECL synchronization and clock ports between the modules and start sampling. All sampling and digital filter timing will be coordinated between modules with less than 10 ns timing skew within a mainframe. This skew is a constant and can be measured and compensated if more precise timing is needed.

Selection of Sample Clocks

You have a choice of sample clocks with the E1438A. The module has two crystal-controlled internal sample clocks. Select the 10 MHz clock for convenient, decimal compatible, time domain sampling. Use the 102.4 MHz internal clock option when downstream signal processing, like the FFT algorithm, needs a binary compatible sample rate.

In addition, you can run the E1438A ADC with an external reference clock to lock sampling to a master 10 MHz timing reference for single channel sample timing accuracy or multi-channel phase coherent sampling.

Large Built-in Memory

Many digital signal processing algorithms use blocks of data. The E1438A has an 18 MByte FIFO memory (144 MB and 288 MB options available) to assemble data into blocks so downstream the DSP doesn't have to. The FIFO type design of the E1438A ensures that new data will not be lost while a data block is being transferred out.

The FIFO also acts as signal capture memory. With the 288 MB FIFO option installed the E1438A has a two-second time capture buffer (100 MSa/s, 12-bit real data format). With the lower data rate 1 MHz decimating filter selected, the FIFO will store three minutes of data. Using the narrower filters will result in even longer signal capture times.

VXIplug&play Programming

The E1438A is shipped with software and documentation to support a broad set of controllers, I/O interfaces, programming languages and operating systems.

Included standard with the E1438A are compiled C libraries (with source code), example programs, online help files, and an installation program. An executable front panel program allows the E1438A to be turned on, verified, and used for simple tasks without writing any user programs.

The E1438A is fully VXI *plug&play* compliant and is easily controlled in Windows 95 and Windows NT VXI *plug&play* frameworks. For those preferring the UNIX operating system, the C-library portion of the HP-UX framework is provided, including the HTML help system and C-example program.

If you are programming in a non-VXI *plug&play* environment you will want to use the E1438A C libraries. The source code is shipped with these libraries so you can modify them to work with your specific I/O and processor.

(Agilent E1438A continued)

High-speed Data Transfer

Sample linearity and signal processing features are wasted if the data stream has gaps because the module output circuits can not keep up with the data generation processes. The E1438A provides two ways to move data to other VXI modules. The VXIbus port on the P1 connector will move data at 2-4 MB/s (typical). This is sufficient for continuous sampling of signals with bandwidths below 500 kHz. For wider signal bandwidths, or multi-channel applications, the local bus is key. Using this port, the E1438A can move data at 66 MB/s in bursts, 50 MB/s continuously.

Data transfer is further aided by a selection of data output formats. Select from four choices:

Component/Sample	Format
Real only (I):	16 bit
Real & imaginary (I/Q):	16 bit
Real only (I):	32 bit
Real & imaginary (I/Q):	32 bit

For More Information

E1438A 100 MSa/s Digitizer with DSP and Memory Product Overview, Pub No. 5968-7348E; E1438A 100 MSa/s Digitizer with DSP and Memory Technical Specifications, Pub No. 5968-8233E.

Product Specifications

Analog Input

Range (in 3 dB steps):	+30 dBm to -21 dBm
Input impedance:	50 ohms (>18 dB return loss, 1.3 VSWR)

Accuracy

Amplitude accuracy:	±0.7 dB (analog alias filter on, power measurement at 10 MHz, 0 to -40 dBfs)
Flatness:	±1.0 dB (dB relative to 10 MHz, excluding digital filter response, analog alias filter on, frequency < 40 MHz)
dc offset:	< ±0.1 mV / ° C (typical)

Dynamic Range

Resolution:	12 bits
Harmonic distortion:	-65 dBc down to -90 dBfs
Residual spurious signals:	< -90 dBfs (with 50 ohm termination at input connector, 2 kHz to 40 MHz)

Clock

ADC clock sources:	Internal, external
Internal clock frequency:	100 MSa/s or 102.4 MSa/s (program controlled)
Internal clock accuracy:	± 700 Hz (0 to 40° C)
External sample clock frequency range:	10 MHz to 102.4 MHz

Filtering

Analog alias filter:	40 MHz, switchable
Digital filters:	305 Hz to 20 MHz, octave steps
Digital LO:	Tunes the center frequency of any digital filter between dc and 40 MHz (less half the filter width) with 0.001 Hz resolution

Memory

Size:	18 MB, 144 MB (Opt 144), 288 MB (Opt 288)
Type:	FIFO

Programming

Output data format:	16-bit real, 32-bit real, 16-bit complex, 32-bit complex
Data output modes:	VME data transfers, local bus data transfers
Measurement modes:	Block, continuous

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A16/D16/D32
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	n/a
VXI buses:	Local Bus A-row (left) Local Bus C-row (right) ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

Watts/slot:	50
ΔP mm H ₂ O:	0.67 (10° C heat rise)
Air Flow liter/s:	3.3 (10° C heat rise)

Module Current

	I _{PM} (A)	I _{DM} (A)
+5 V:	4.3	0.3
+12 V:	0.6	0.3
-12 V:	0.3	0.02
+24 V:	0.04	0.02
-24 V:	0.04	0.02
-5.2 V:	2.9	0.1
-2 V:	0.7	0.1

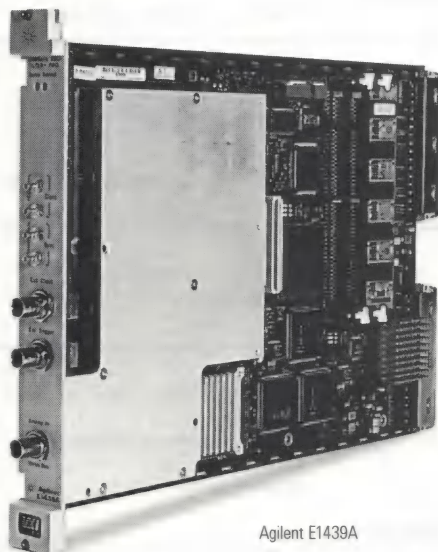
Ordering Information

Description	Product No.
100 MSa/s VXI ADC with Filters and Memory	E1438A
144 MB total RAM	E1438A 144
288 MB total RAM	E1438A 288

Publication No.: 5968-8233E

95 MSa/s Digitizer with 70 MHz IF Input

Agilent E1439A



Agilent E1439A

- dc to 36 MHz input
- -90 dBfs residual spurious free dynamic range
- 70 MHz IF input
- Anti-alias filter and signal conditioning
- Center frequency tunable digital decimation filters
- 18 MB RAM FIFO memory (288 MB available)

Description

The Agilent Technologies E1439A 95 MSa/s ADC with filters and memory is a C-size, 1-slot, register-based VXI module that provides you high-resolution digitizing at a faster sample rate than ever before from Agilent. Along with -90 dBfs spurious free dynamic range and 95 MSa/sec digitizing, it features full input signal conditioning for its IF input, tunable digital filtering, a large signal capture memory, and high-speed data ports.

Full input signal conditioning for the 70 MHz IF input matches the Agilent E1439A operating range to your signal and protects the digitizer from harmful over-voltages. ac/dc coupling and attenuation are standard. A 36 MHz anti-alias filter supports data-efficient Nyquist sampling.

Use the real-time digital filters to enhance signal to noise ratio and select specific signals for analysis. Capture signals in the 18 MB FIFO memory (144 MB and 288 MB optional). This also memory assembles the output data stream into data blocks, the format most DSP algorithms prefer.

Use the trigger, external clock and synchronization features for phase coherent sampling using multiple Agilent E1439As. Multiple high-speed data output formats are provided including real and I&Q formats.

The Agilent E1439A is fully VXIplug&play compliant.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

A New Digitizer

The heart of the Agilent E1439A is a new, Agilent-designed, 95 MSa/s digitizer. This high-performance monolithic component provides clean, low-distortion samples at a higher sample rate than ever before offered by Agilent.

Signal analysis algorithms produce better results when supplied with precise samples. Spurs and distortion in the data limit the output precision of algorithms like RMS averaging, the Fast Fourier Transform, and various curve-fitting algorithms. Reduce these contaminants and you get more precise results.

Sample linearity and purity are the key and the Agilent E1439A provides the answer. Spurious signal contamination is at least -90 dBfs (below full scale). Harmonic distortion is down -65 dBc and noise density is -132 dBfs/Hz.

Built-in Digital Filtering and LO

The standard Agilent E1439A includes digital decimation filtering and a programmable LO. Use the real-time filters to reduce noise and improve signal to noise ratio, or to filter out unwanted signals. The 17 filters provided reduce the analysis bandwidth of the Agilent E1439A from 36 MHz to 305 Hz in octave steps.

These filters also improve data efficiency. The data from each filter is decimated to reduce data rate and data quantity without losing any signal information.

Included in the filter section is a digital LO. Use this complex frequency shifter to tune the center frequency of each digital filter anywhere in the 36 MHz input bandwidth of the Agilent E1439A.

The LO is a big help when you have to process digital modulation formats. The LO action is implemented using quadrature mixing, which produces the I/Q data needed for this task. These digital I and Q results are better matched and have lower spurious content, less than -90 dBfs, than I/Q signals produced by analog means. And, the LO's 0.001 Hz resolution is vital for the precise tuning needed to stop a rotating constellation diagram.

Analog Signal Conditioning Includes Alias Protection

The Agilent E1439A comes with analog signal conditioning, including a bypassable 36 MHz anti-alias filter. The anti-alias filter ensures the Nyquist-compatible sampling needed by most signal processing algorithms. The signal conditioning makes it easy to match the Agilent E1439A operating point to your signal amplitude, and protects the digitizer from harmful voltages. Input bandwidth without alias protection is 100 MHz (typical).

Flexible Triggering and Synchronization

Select one of several ways to trigger the Agilent E1439A. Use **immediate** to begin sampling automatically. Select the **external trigger** mode when sampling must start coincident with an external event. Use the **level** mode to trigger on the level of the input signal itself. A **software trigger** command is also provided.

Large pre- and post-trigger delays (>100 MSamples with the memory option) are standard and the external trigger modes support slope selection.

Use the external synchronization and external clock features of the Agilent E1439A when your application requires closely coordinated sampling with multiple Agilent E1439As. Simply connect the ECL synchronization and clock ports between the modules and start sampling. All sampling and digital filter timing will be coordinated between modules with less than 10 ns timing skew within a mainframe. This skew is a constant and can be measured and compensated if more precise timing is needed.

Selection of Sample Clocks

You have a choice of sample clocks with the Agilent E1439A. The module has two crystal-controlled internal sample clocks. Select the 100 MHz clock for convenient, decimal compatible, time domain sampling. Use the 102.4 MHz internal clock option when downstream signal processing, like the FFT algorithm, needs a binary compatible sample rate.

In addition, you can run the Agilent E1439A ADC with an external reference clock to lock sampling to a master 10 MHz timing reference for single channel sample timing accuracy or multi-channel phase coherent sampling.

Large Built-in Memory

Many digital signal processing algorithms use blocks of data. The Agilent E1439A has an 18 Mbyte FIFO memory (144 MB and 288 MB options available) to assemble data into blocks so downstream the DSP doesn't have to. The FIFO type design of the Agilent E1439A ensures that new data will not be lost while a data block is being transferred out.

The FIFO also acts as signal capture memory. With the 288 MB FIFO option installed the Agilent E1439A has a two-second time capture buffer (95 MSa/s, 12-bit real data format). With the lower data rate 1 MHz decimating filter selected, the FIFO will store three minutes of data. Using the narrower filters will result in even longer signal capture times.

(Agilent E1439A continued)

VXIplug&play Programming

The Agilent E1439A is shipped with software and documentation to support a broad set of controllers, I/O interfaces, programming languages and operating systems.

Included standard with the Agilent E1439A are compiled C libraries (with source code), example programs, online help files, and an installation program. An executable front panel program allows the Agilent E1439A to be turned on, verified, and used for simple tasks without writing any user programs.

The Agilent E1439A is fully VXIplug&play compliant and is easily controlled in Win32 VXIplug&play frameworks. For those preferring the UNIX operating system, the same set of software is provided for HP-UX running on HP Series 700 workstations.

If you are programming in C in a non-VXIplug&play environment you will want to use the Agilent E1439A C libraries. The source code is shipped with these libraries so you can modify them to work with your specific I/O and processor.

High-speed Data Transfer

Sample linearity and signal processing features are wasted if the data stream has gaps because the module output circuits can not keep up with the data generation processes. The Agilent E1439A provides two ways to move data to other VXI modules. The VXIbus port on the P1 connector will move data at 2 to 4 MB/s (typical). This is sufficient for continuous sampling of signals with bandwidths below 500 kHz. For wider signal bandwidths, or multi-channel applications, the Local Bus is key. Using this port, the Agilent E1439A can move data at 100 MB/s in bursts, 80 MB/s continuously.

Data transfer is further aided by a selection of data output formats. Select from four choices:

Component/Sample	Format
Real only (I):	16 bit
Real & imaginary (I/Q):	16 bit
Real only (I):	32 bit
Real & imaginary (I/Q):	32 bit

For More Information

Agilent E1439A 95 MSa/s Digitizer with DSP and Memory Product Overview, Pub No. 5980-1260E.

Product Specifications

Analog Input

Range:

Baseband path: One range, -21 dBm, 28.2 mVp
 70 MHz IF path: -36 dBm to +12 dBm, in 1 dB steps,
 5.02 mVp to 1.26 Vp, in 1 dB steps

Input impedance:

Baseband path: 50 Ω impedance
 0.1 to 36 MHz: >15 dB
 (1.4 : 1 VSWR)
 70 MHz IF path: 52 to 88 MHz: >9 dB
 (2.1 : 1 VSWR)

Accuracy

Amplitude accuracy (power measurement, 0 to -40 dBfs, anti-alias filter ON):

Baseband path, at
 10 MHz: ± 0.7 dB
 70 MHz IF path, at
 70 MHz: ± 1.5 dB

Flatness

(excluding digital filter response):

Baseband path, 0 to
 36 MHz, relative to 10 MHz: +0.5, -1.2 dB
 Baseband path, AAF off, at 100 MHz: -15 dB (typ.)
 70 MHz IF path, 52 to 88 MHz, relative
 to 70 MHz: +0.5, -3.0 dB
 dc offset: $< \pm 0.1$ mV / ° C (typ.)

Dynamic Range

Resolution: 12 bits
 Harmonic distortion: -62 dBc down to
 -90 dBfs

Residual spurious signals: < -90 dBfs (with 50 Ω termination at
 input connector, in-band response)

Clock

ADC clock sources: Internal, external
 Internal clock frequency: 95 MSa/s
 Internal clock accuracy: ± 7 ppm (0 to 40° C)
 External sample clock frequency
 range: 10 MHz to 102.4 MHz, baseband only

Filtering

Analog alias filter: 36 MHz, switchable
 Digital filters: 305 Hz to 20 MHz, octave steps
 Digital LO: Tunes the center frequency of any
 digital filter between dc and 36 MHz
 (less half the filter width) with 0.01 Hz
 resolution

Memory

Size: 18 MB, 144 MB (Opt 144),
 288 MB (Opt 288)
 Type: FIFO

Programming

Output data format: 16-bit real, 32-bit real, 16-bit complex,
 32-bit complex
 Data output modes: VME data transfers, Local Bus data
 transfers
 Measurement modes: Block, continuous

General Specifications

VXI Characteristics

VXI device type: Register based
 Data transfer bus: A16/D16/D32
 Size: C
 Slots: 1
 Connectors: P1/P2
 Shared memory: n/a
 VXI buses: Local Bus A-row (left)
 Local Bus C-row (right)
 ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website
 (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: n/a
 Command module firmware rev: n/a
 I-SCPI Win 3.1: n/a
 I-SCPI Series 700: n/a
 C-SCPI LynxOS: n/a
 C-SCPI Series 700: n/a
 Panel Drivers: Yes
 VXIplug&play Win Framework: n/a
 VXIplug&play Win95/NT Framework: Yes
 VXIplug&play HP-UX Framework: Yes

Cooling/Slot

Watts/slot: 65
 ΔP mm H₂O: 0.67 (10° C heat rise)
 Air flow liter/s: 3.3 (10° C heat rise)

Module Current

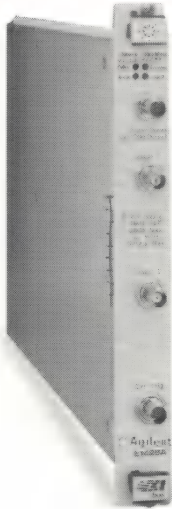
	I _{PM} (A)	I _{DM} (A)
+5 V:	4.3	0.3
+12 V:	0.6	0.3
-12 V:	0.3	0.02
+24 V:	0.04	0
-24 V:	0.04	0
-5.2 V:	2.9	0.1
-2 V:	0.7	0.1

Ordering Information

Description	Product No.
95 MSa/s VXI ADC with Filters and Memory	E1439A
144 MB total RAM	E1439A 144
288 MB total RAM	E1439A 288
Publication No.: 5980-1260E	

1 GSa/s VXI Oscilloscope

Agilent E1428A



Agilent E1428A

- 1-Slot, C-size, message based
- 250 MHz bandwidth, 2 channels
- 1 GSa/s maximum sample rate
- Fast throughput with 1 MB shared RAM
- Automatic pulse parameter measurements
- Recommended for transient signals

Description

The Agilent Technologies E1428A Digitizing Oscilloscope is a **C-size, 1-slot, message-based VXI module**. It has two channels with each channel containing an 8-bit A/D, and 8,000 point memory to simultaneously capture at up to 1 GSa/s. This preserves the timing correlation of both channels without a reduction in sample rate.

For fast capture of many waveforms, the E1428A offers sequential single-shot mode which internally stores successive waveforms rapidly. The memory can be optimized for acquisition speed or capacity. There are 100 K-words of internal RAM or 500 K-words of shared RAM for segment storage.

The E1428A comes with both the SCPI command set and an Agilent 54510A-compatible command set. The compatible language provides a use model where programs can be developed using the 54510A bench oscilloscope. Using the 54510A provides direct visual feedback to the programmer during program development. Once programs have been developed on the 54510A, they can be run on the E1428A with only minor modifications.

The SCPI language is available for users who are more familiar with SCPI. Not all of the complex triggering capabilities of the 54510A and E1428A are implemented in the SCPI language.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

E1428A Features

Built-in Automatic Test Features

The user can choose from a variety of powerful measurement features that are built into the E1428A, thus simplifying test program development and improving test times.

Nineteen automatic pulse parameter measurements are available in the box, freeing the controller from these calculations. These measurements conform to IEEE definitions. Maximum and minimum statistics on the values of these measurements are also accumulated.

The following measurements are made at user-defined thresholds or at the 10/90% or 50% voltage thresholds, as defined by IEEE Std 194-1977: rise time, fall time, frequency, period, +pulse width, -pulse width, duty cycle, delay, volts ampl, volts base, volts top, volts p-p, volts avg, volts max, overshoot, preshoot, volts min, Vac rms, Vdc rms.

GO/NO-GO testing is provided by another built-in feature:

Measurement Limit Test lets the user set upper and lower limits on any of the module's automatic measurements. If limits are exceeded, the violating waveform and its data can be stored or transferred to the controller.

In addition to the measurement limit test for GO/NO-GO testing, the E1428A provides built-in waveform compare test. With this feature, a live signal can be compared against a stored template.

Shared RAM On Board Eliminates Bus Transfer Time

1 MB of shared RAM allows storage and retrieval of waveform data as well as direct access to that data by the VXI controller or other instrument modules. Since the controller operates directly on the data in shared RAM, bus transfer of waveforms can be eliminated. Up to 45 milliseconds of bus transfer time can be saved.

Choice of Two Command Sets

- SCPI Command Set—Based on the industry standard SCPI definitions for instrument programming.
- 54500-Compatible Command Set—Program the E1428A like the 54510B bench oscilloscopes.

Advanced Logic Trigger

Agilent's advanced logic triggering can be used to trigger on glitches as well as a wide variety of user specified conditions. You can trigger on edge, pattern, time-qualified trigger, state, or trigger-after-delay to capture such elusive events as timing violations or infrequent bus phenomena. Using the built-in TV trigger, you can select line and field for a variety of video waveforms. And you can use the E1428A's ability to send and receive VXI backplane triggers to combine the power of multiple VXI instruments.

Probes

The E1428A is compatible with the 54510B benchtop oscilloscope. Therefore, probes for the benchtop oscilloscope work with the VXI oscilloscope. Refer to the Agilent Test and Measurement catalog for probe ordering information.

Product Specifications

Specifications valid for temperature range $\pm 10^\circ\text{C}$ from software calibration temperature with eight or more averages selected.

Bandwidth (–3 dB), repetitive:	dc to 250 MHz
Bandwidth (–3 dB), single-shot:	dc to 250 MHz
Maximum sample rate:	1 GSa/s (simultaneously on both ch.)
Waveform record length:	8,000 points (real time) 500 points (repetitive)
Number of inputs:	2 simultaneous acquisition inputs, 1 external trigger input (Note: E1428A has 2 acquisition inputs, both with 1 GSa/s A/D converters, so both repetitive and single-shot acquisitions are taken on both input channels simultaneously.)
Output BNC(s):	Probe comp, Cal. Trigger out
Vertical sensitivity range:	8 mV to 40 V full scale
Vertical gain accuracy (dc):	$\pm 1.25\%$ of full scale
Vertical resolution:	$\pm 0.4\%$ (8 bit A/D) $\pm 0.1\%$ (10 bits with averaging)
Input R (selectable):	1 M Ω or 50 Ω
Input C:	7 pF nominal
Input coupling:	ac, dc
Maximum input voltage:	1 M Ω : $\pm 250\text{ V}$ 50 Ω : 5 V rms $\pm (1\%$ of channel offset, + 2% of full scale)
Offset accuracy:	
Offset range:	Up to $\pm 250\text{ V}$
Time base range:	10 ns to 50 s full scale
Delta-t accuracy, repetitive:	$\pm (0.005\% \times \text{delta-t} + 2^{-6} \times \text{delay setting} + 150\text{ ps})$ for ≥ 8 averages
Delta-t accuracy, single-shot:	$\pm (0.005\% \times \text{delta-t} + 2^{-6} \times \text{delay setting} + 150\text{ ps})$
Time base resolution:	20 ps
Minimum trigger pulse width:	Internal: 1.75 ns External: 2.8 ns
VXI backplane triggering:	ECL
Number of instrument setups:	48
VXI shared memory, amount:	1 MB

(Agilent E1428A continued)

General Specifications

VXI Characteristics

VXI device type:	Message based
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	Yes
VXI buses:	ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	n/a
C-SCPI Series 700:	n/a
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	1.93	0.09
+12 V:	0.8	0.08
-12 V:	0.09	0.01
+24 V:	0.03	0.01
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

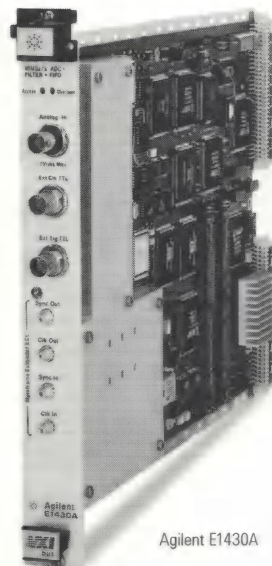
Watts/slot:	30.00
ΔP mm H ₂ O:	0.30
Air Flow liter/s:	2.40

Ordering Information

Description	Product No.
1 GSa/s Digitizing Oscilloscope	E1428A
ANSI Z540 Compliant Calibration	E1428A A6J
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1428A W01
Oscilloscope User's Guide	E1428-97001
Publication No.: 5965-5581E	

10 MSa/s ADC with Filters and Memory

Agilent E1430A



Agilent E1430A

- 18 bit (110 dBfs) spurious free dynamic range
- Alias protection and signal conditioning
- Frequency tunable digital filters
- 8 MB FIFO memory
- Flexible triggering and synchronization
- Local bus data rates up to 25 MB/sec

Description

The Agilent Technologies E1430A 10 MSa/s ADC, a **C-size, 1-slot, register-based VXI module**, is more than just a digitizer—it is a complete ADC module. Included with it is a low-distortion, low-noise digitizer, flexible input signal conditioning, frequency tunable digital filters and a FIFO type memory.

The digitizer in the E1430A provides 23 bits of resolution with up to 18 bits (–110 dBfs) of spur and distortion free dynamic range. That means high quality data that will enhance your analysis results. Its input is fully alias protected enabling data efficient Nyquist sampling. It also has multiple digital filters and a digital LO. Use these filters to reduce the noise in your data and single out signals for specific analysis.

Adjust the E1430A to your signal's magnitude with 11 attenuation/gain ranges and ac/dc coupling. Capture transient signals in the 8 MB FIFO memory. Use this memory to assemble the output data stream into data blocks, the format most DSP algorithms prefer.

Select one of five ways to trigger the E1430A to help assure your measurement starts at exactly the right time. Use the external clock and synchronization features for phase coherent sampling using multiple E1430As.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

For More Information

E1430A Technical Specifications, pub no. 5962-9496E

E1430A Product Note, pub no. 5962-9497E

E1430A-1 Product Note, pub no. 5962-0015E

18-Bit (110 dBfs) Spurious Free Dynamic Range

The digitizer used in E1430A is a two-pass (or sub-ranging) type that provides 23 bits of raw resolution. It uses a combination of dithering and an extraordinary on-the-fly distortion correction technique to produce up to 18 bits (–110 dBfs) of distortion-free dynamic range.

Not only is the E1430A digitizer low distortion, it is also low noise. Noise density is –136 dBfs/Hz, which, on the lowest input range results in a 15 dB noise figure.

(Agilent E1430A continued)

Alias Protection and Signal Conditioning

The E1430A has a switchable, 4 MHz input alias protection filter to assure data efficient Nyquist sampling. Full input signal conditioning makes it easy to match the E1430A operating point to your signal amplitude, while protecting the digitizer from harmful over-voltages. ac/dc coupling, and 11 attenuation/gain ranges mean you can digitize 8 Vpk signals with or without dc offsets. And a "pseudo-floating" input feature breaks up signal contaminating ground loops.

Frequency Tunable Digital Filters

Sometimes you need to narrow in on a signal to exclude unwanted signals or noise. The E1430A features multiple digital decimating filters, and a digital LO. Filter bandwidths range from 2 MHz to 0.24 Hz, in octave steps. After the data is filtered, it is decimated, reducing the effective sample rate and the amount of memory required to store it, while maintaining alias-protected Nyquist sampling.

Tune the digital LO to center any of the digital filters on your signal to maximize rejection of unwanted signals. The action of the LO on the signal also produces I and Q data, ideal for algorithmic processes that need complex data to compute successfully.

8 MB FIFO

The built-in 8 MB FIFO can act as a signal capture memory. It can hold 400 ms of data (16-bit mode, 10 MSa/s sample rate). Signal processing algorithms, like the Fast Fourier Transform, process data in blocks rather than as an uninterrupted stream. The E1430A FIFO memory can automatically assemble output data in blocks. And the FIFO design ensures new data will not be lost while a data block is being transferred out.

Flexible Triggering and Synchronization

Select one of five ways to trigger the E1430A. Use "immediate" mode to begin sampling automatically. Select the "external trigger" mode when sampling must start coincident with an external event. Use "level" mode to trigger on the level of the input signal. Use "log magnitude" mode to trigger on the magnitude of the signal after it has gone through the digital filters.

Large pre- and post-trigger delays (>1 MSample) are standard and the external trigger modes support slope selection.

Synchronize sampling and digital filtering between modules by connecting the ECL synchronization and clock ports between modules. Less than 10 ns timing skew is maintained within a mainframe.

Local Bus Data Rates Up to 25 MB/sec

Sample linearity and signal processing features are wasted if the data stream has gaps because the module output ports can not keep up with the data digitizing rate. The E1430A provides two ports to move data to other VXI modules. The VXIbus port on the P1 connector will pass data at >1 MB/s, typical. This is sufficient for continuous sampling of signals with bandwidths below 250 kHz.

For wider signal bandwidths, or multi-channel applications, the Local Bus is key. Using this port the E1430A can achieve 25 MB/s data rates, sufficient for continuous sampling of 4 MHz signal bandwidths.

Backplane Connector Shielding

To ensure compliance with RFI levels specified in standards EN55001 and CISPR11, this product requires the backplane connector shields installed in an Agilent VXI C-size mainframe.

Option 918 is available with the purchase of a new mainframe; accessories, Agilent P/Ns E1400-80920, E1421-80920, and E8400-80918 (one kit per mainframe) are available for retrofitting existing Agilent mainframes E1401A/B, E1421B, and E84XXA, respectively.

Product Specifications**Analog Input**

Range (in 6 dB steps):	+28 dBm to -32 dBm
Input Impedance:	50 Ω , >40 dB return loss, 4 MHz, dc coupled

Accuracy

Basic accuracy (amplitude):	± 0.03 dB
Absolute voltage measurement:	± 0.03 dB (dc coupled, $f < 100$ kHz, decimation filters off, 1 V range, dc coupled, analog anti-alias filter on)
Range accuracy:	± 0.03 dB (relative to 1 V range, for all ranges, $f < 100$ kHz)
Temperature accuracy:	<0.001 dB per °C of deviation from 25° C

Dynamic Range

Resolution:	23 bits
Harmonic distortion:	<-110 dBfs or -80 dBc, whichever is greater
Spurious signals:	<-110 dBfs, using internal clock (includes alias products)

Clock

ADC clock sources:	Internal, external BNC input compatible with TTL, ECL, and >-6 dBm sine waves
Internal ADC clock frequency:	10 MHz and 10.24 MHz (opt AYD)
ADC clock accuracy:	± 70 Hz (internal 10 MHz, 0 to 40° C)

Trigger

Sources:	External TTL with \pm slope select, signal level, signal magnitude, software initiated, immediate
Trigger delay:	Yes, pre- and post-
Trigger:	Next event

Filtering

Analog anti-alias filter:	4 MHz, switchable
Digital filters:	0.24 Hz to 2 MHz, octave steps
Digital LO:	Tunes the center frequency of any digital filter between dc and 4 MHz (less half the filter width) with 10 MHz resolution.

Memory

Size:	8 MB
Type:	FIFO

Programming

Output data format:	16-bit real, 32-bit real, 16-bit complex, 32-bit complex
Data output modes:	VME data transfers, local bus data transfers
Measurement modes:	Block, continuous
Data interrupt:	Two independent priority interrupts initiated by masked status bits

General Specifications**VXI Characteristics**

VXI device type:	Register based
Data transfer bus:	A16, D16
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	Local Bus A-row (left) Local Bus C-row (right) ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	C Libraries
I-SCPI Series 700:	C Libraries
C-SCPI LynxOS:	No
C-SCPI Series 700:	C-SCPI not required, C libraries included
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Cooling/Slot

Watts/slot:	48.00
ΔP mm H₂O:	0.44
Air Flow liter/s:	3.84

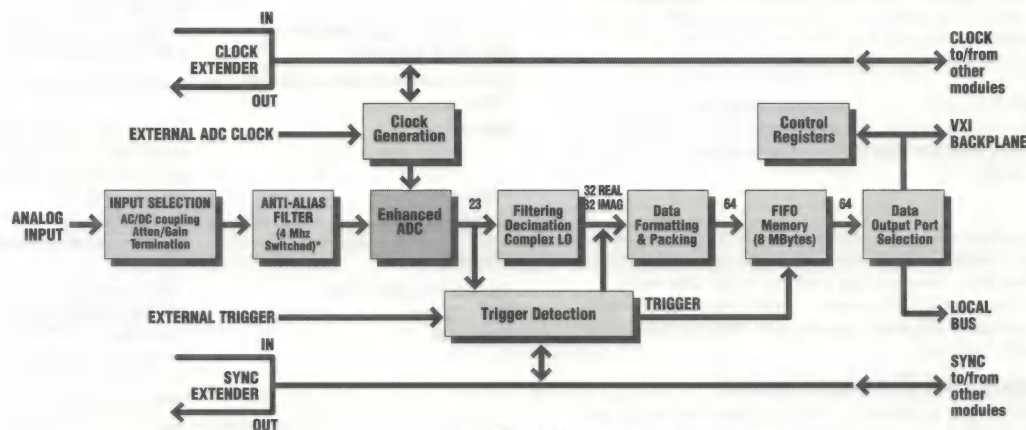
(Agilent E1430A continued)

Module Current

	I_{PM}	I_{DM}
+5 V:	4.2	0.5
+12 V:	0.3	0.05
-12 V:	0.1	0.02
+24 V:	0	0
-24 V:	0	0
-5.2 V:	4.2	0.2
-2 V:	0.3	0.1

Ordering Information

Description	Product No.
10 MSa/s Digitizer with Filters and Memory	E1430A
Service Manual	E1430A 0B3
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E1430A W01
Backplane Connector Shield Kit	E1400-80920
VXI Backplane Connector Shield Kit	
for 6-Slot Mainframe (if ordered separately)	E1421-80920
Backplane Connector Shields Kit	E8400-80918



*8 Mhz for E1437A

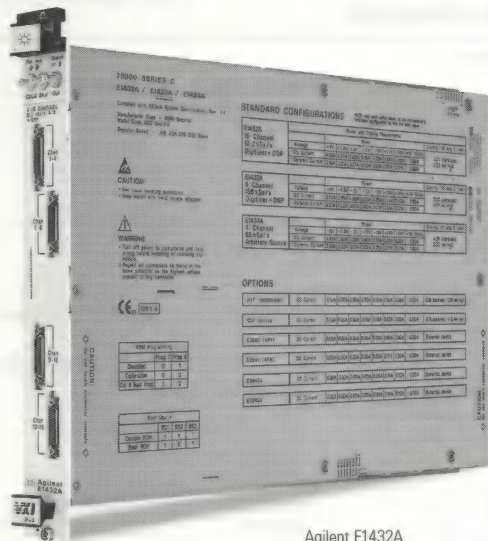
Agilent E1430A Block Diagram

Publication No.: 5962-9496E

15

16-Channel 51.2 kSa/sec Digitizer Plus DSP

Agilent E1432A



Agilent E1432A

Description

The Agilent Technologies E1432A 16-Channel Digitizer is a **C-size, 1-slot, register-based VXI module**. It includes DSP, transducer signal conditioning, alias protection, digitization, and high-speed measurement computation. You can even add an optional arbitrary source or dual-input tachometer. Putting so much capability in a single module decreases system costs while increasing system performance.

This digitizer module excels at parallel processing of data, a key to high system performance. On-board DSP computes measurement results in the input module, preventing the host computer from being a performance bottleneck. Adding more E1432As to a system adds more DSP capability, maintaining system performance for even extremely large systems.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Get Data in Four Domains

The E1432A turns data into information by providing the data in whichever domain gives the most insight. Digitized data can be a simple time record, or the E1432A can use onboard DSP to compute FFTs and power spectrums to provide the data in the frequency domain. For rotating machinery analysis the E1432A can measure amplitude as a function of shaft angle, or as multiples of the shaft RPM using order ratio spectrums. Since these measurements are built into the module, no user programming is required.

Key E1432A Features

Here are some of the E1432A's other significant features:

- Grounded or differential inputs
- Digital anti-alias filters
- Simultaneous sample and hold
- Zoom (non-zero start frequency)
- 16 delta-sigma ADCs

- On-board DSP improves total system performance
- Built-in signal conditioning simplifies tests and reduces cost
- Sample rates from 51.2 kHz to 25.6 Hz (per channel) simultaneous
- Alias protected bandwidths from 23 kHz to 10 Hz
- Optional 16/20-bit arbitrary source
- Optional dual tachometer

(Agilent E1432A continued)

Signal Conditioning is Built In

Four different breakout boxes provide remote connections to voltage, IEPE accelerometers, microphones, and piezoelectric transducers. By putting transducer signal conditioning in the interchangeable breakout boxes, the E1432A can support mixed transducer types. To change test transducers, just change the breakout boxes.

Exceptionally Fast Data Capture

The expandable RAM FIFO in the E1432A continuously buffers up filtered time data from the input channels. Expanding the RAM to 32 MB provides 1 Msample of data storage per channel. If 1 Msample per channel is not enough, you can throughput the data to an Agilent N2216A VXI/SCSI Interface Module. The N2216A can transfer data at a 15 per-second rate to an external SCSI device or to the optional internal hard drives (one 50 GB drive or two 50 GB drives). Data may be monitored during throughput. The host can "eavesdrop" on the data as it is passed to the N2216A, displaying either raw time data or FFT results.

Optional Output for Stimulus

A 16/20-bit arbitrary source can be added to provide sine, burst sine, swept sine, random and burst random stimulus for testing structures or devices. Since it does not take up extra slots, it saves money and space. It has a constant output level amplifier (COLA) for signal monitoring, a summing junction for adding the outputs of multiple sources, and a programmable rampdown rate.

Optional Dual Tachometer Input

For testing rotating machinery the E1432A has an optional dual tachometer input. Use it to tag acquired data with the actual RPMs when the data was taken. Or use it to trigger data acquisitions at specified RPM intervals between specified start and stop RPMs.

Backplane Connector Shielding

To ensure compliance with RFI levels specified in standards EN55001 and CISPR11, this product requires the backplane connector shields installed in an Agilent VXI C-size mainframe.

Option 918 is available with the purchase of a new mainframe; accessories, Agilent P/Ns E1400-80920, E1421-80920, and E8400-80918 (one kit per mainframe) are available for retrofitting existing Agilent mainframes E1401A/B, E1421B, and E84XXA, respectively.

For More Information

E1432A, E1433B, E1434A VXI Digitizers/Source Product Overview, pub. no.: 5968-7086E; E1432A Technical Specifications, pub. no.: 5968-8729E.

Product Specifications**General**

Number of channels:	16
Bandwidth:	23 kHz
Alias protection:	Anti-Aliasing Filter built-in
Timebase resolution:	20 μ s
Low-frequency CMRR:	50 dB
Variable bandwidth:	Yes
2 dB Input range headroom:	Yes
Pre-arm capture:	Yes
Dual-ported memory:	Yes
Dual-rate sampling:	No
Segmented memory:	No

Frequency

Sample rates:	51.2 Sa/s to 25.6 Sa/s (internal clock)
Alias protected frequency spans:	23 kHz to 10 Hz
Zoom frequency span:	2 kHz, 500 Hz, 125 Hz, 31.25 Hz
Zoom center frequency:	\leq 4 kHz

Input

Full scale input ranges:	100 mVpk to 20 Vpk (1, 2, 5 steps)
Input impedance:	
Differential:	1 M Ω , 35 pF
Grounded:	500 k Ω , 35 pF
ac coupling 3 dB frequency:	1 Hz
Common mode rejection ratio:	
Frequency:	1 kHz
dc coupled:	>50 dB
ac coupled:	>45 dB
Residual dc after auto-zero:	\leq 10 mV

Amplitude

Basic accuracy:	0.7%
Amplitude accuracy at 1 kHz:	\pm 0.7% (\pm 0.06 dB)
Flatness relative to 1 kHz:	\pm 1% (\pm 0.086 dB)

Cross Channel Matching

(in the same mainframe)

Cross channel magnitude:	\pm 1.2% (\pm 0.1 dB)
Cross channel phase:	
23 kHz:	\pm 2.5 degrees
1 kHz:	\pm 0.125 degrees
Cross-mainframe time delay:	70 nsec delay typ. + 6 nsec/m of cable

Dynamic Range

Resolution:	16 bits
Spurious-free dynamic range:	80 dBfs, 90 dBfs typical
Total harmonic/intermod distortion:	-80 dBfs
FFT noise floor:	<-90 dBfs
Channel to channel crosstalk:	-80 dBfs
Input noise level (above 100 Hz):	300 nV _{rms} /√Hz (Split equally over active channels)
Input channel RAM buffer size:	4 MB (2 Msample) standard 32 MB (16 Msample) optional
Memory:	4-32 MB

Data Transfer Rates

Up to 819.2 ksamples per second per module, depending on I/O and computer being used. Refer to E1432A Technical Specifications, Pub No. 5968-8729E.

Triggering Types

Input, external, source, TTL TRG, RPM (requires AYF option).
Trigger: Next sample

E1432A/33B/34A sample rates and triggering can be synchronized across multiple modules and mainframes.

Maximum trigger delay:

Note: 16 channels active

	4 MB RAM	32 MB RAM
Pre-trigger:	131 kSa	1 MSa
Post trigger:	16 MSa	16 MSa

DSP Measurement Results

Build-in DSP:	Yes
Time domain:	Time
Frequency domain:	Windowed FFT, power spectrum
Revolution domain:	Sample at tach times
Order domain:	RPM triggered order ratio spectrums
Window types:	Uniform, Hann, Flattop
Averaging types:	RMS, linear, exponential, peak hold
Lines of resolution:	
Frequency domain:	50 to 3,200
Order domain:	50 to 1,600

Signal Conditioning

8-channel voltage breakout box:	8 BNC connectors
8-channel voltage/IEPE breakout box:	8 BNC connectors with switchable voltage/IEPE
IEPE current:	4 mA
Open circuit voltage:	24 V
4-channel Mic/voltage/IEPE breakout box:	4 channels with LEMO connectors 0/200 V polarization voltage 28 V preamp power
4-channel charge/voltage/IEPE breakout box:	4 BNCs with switchable IEPE/voltage 4 channels with microdot connectors 4 BNCs with switchable IEPE/voltage

(Agilent E1432A continued)

Optional Arbitrary Source

Output:

Full-scale ranges: 10 V to 80 mV
Output impedance: <0.5 Ω typical

Output modes:

Sine: Continuous, burst, swept
Random: Pseudo, periodic, burst, mooz
Arbitrary output: Continuous, loop

Sine frequency range:

Frequency range: 0 to 25.6 kHz
Frequency resolution: 244 μ Hz

Random Noise bandwidth:

Frequency spans: 25.6 kHz to 0.4 Hz
Mooz spans: 2 kHz to 156 mHz
Mooz center frequency: <4 kHz

Arbitrary output signal bandwidth:

20 bit: 6.4 kHz
16 bit: 25.6 kHz
Arbitrary output dual buffer size: 40,960 samples/buffer

Optional Dual Tachometer Input

Maximum input voltage: ± 25 V
Maximum tach pulses/sec: 100 kHz

Max pulse rate: 100 kHz
Max pulses/rev: 65,535

General Specifications

VXI Characteristics

VXI device type: Register based
Data transfer bus: A16, A32, D32 slave only
Size: C
Slots: 1
Connectors: P1/2
Shared memory: n/a
VXI buses: Local Bus A-row (left)
Local Bus C-row (right)
TTL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: No
Command module firmware rev: n/a
I-SCPI Win 3.1: No
I-SCPI Series 700: No
C-SCPI LynxOS: No
C-SCPI Series 700: C-SCPI not required, C libraries included
Panel Drivers: No
VXIplug&play Win Framework: No
VXIplug&play Win 95/NT Framework: Yes
VXIplug&play HP-UX Framework: Yes

Module Current

E1432A

	I_{PM}	I_{DM}
+5 V:	4.9	0.1
+12 V:	0.19	0.02
-12 V:	0.05	0.01
+24 V:	0.45	0.01
-24 V:	0.45	0.01
-5.2 V:	0.6	0.01
-2 V:	0.03	0.01

E1432A Opt AYF

	I_{PM}	I_{DM}
+5 V:	0.14	0
+12 V:	0	0
-12 V:	0	0
+24 V:	0.1	0
-24 V:	0.06	0
-5.2 V:	0	0
-2 V:	0	0

E1432A Opt 1D4

	I_{PM}	I_{DM}
+5 V:	0.6	0
+12 V:	0.19	0
-12 V:	0.18	0
+24 V:	0.03	0
-24 V:	0.03	0
-5.2 V:	0	0
-2 V:	0	0

E1432A Opt AFV

	I_{PM}	I_{DM}
+5 V:	0	0
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

E1432A Opt AFW

	I_{PM}	I_{DM}
+5 V:	0	0
+12 V:	0	0
-12 V:	0	0
+24 V:	0.17	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot: 58.20
 ΔP mm H₂O: 0.46
Air Flow liter/s: 5.20

Ordering Information

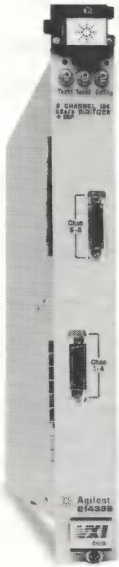
Description	Product No.
16-Channel 51.2 kSa/s Digitizer plus DSP	E1432A
Delete Manual Set	E1432A 0B0
Add Manual Set	E1432A 0B1
Mil std 45662A Calibration w/Test Data	E1432A 1BP
Arbitrary Source	E1432A 1D4
Delete 12 Input Channels	E1432A 1DD
Delete 8 Input Channels	E1432A 1DE
Voltage Input Breakout Box	E1432A 1DV
ICP/Voltage Input Breakout Box	E1432A 1FW
Charge/ICP/Voltage Input Breakout Box	E3242E
Microphone/ICP/Voltage Input Breakout Box	E3243E
32 MB Total RAM	E1432A ANC
Dual Rack Mount Kit, 19"	E1432A AXM
Add Tachometer Input	E1432A AYF
Add Local Bus Interface	E1432A UGV
Commercial Cal. Certificate w/Test Data	E1432A UK6
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E1432A W01
Backplane Connector Shield Kit	E1400-80920
VXI Backplane Connector Shield Kit	
for 6-Slot Mainframe (if ordered separately)	E1421-80920
Extra Terminal Block	E1463-80011

Note: OPT 1D4 and AYF cannot be ordered together.

Publication No.: 5968-8729E

8-Channel 196 kSa/sec Digitizer plus DSP

Agilent E1433B



Agilent E1433B

- On-board DSP offloads complex signal processing
- Built-in signal conditioning simplifies tests and reduces cost
- Anti-alias protection from 0.057 Hz to 88 kHz
- High-speed data capture from local bus
- Optional 16/20-bit arbitrary source/dual input tachometer
- Sample rates from 196,608 Hz to 0.146 Hz

Description

The Agilent Technologies E1433B 8-Channel Digitizer plus DSP is a C-size, 1-slot, register-based VXI module. It includes transducer signal conditioning, anti-alias filters, digitization, and high-speed measurement computation in a single-wide module. By tightly integrating this functionality in a single module, the E1433B simplifies making accurate, high-speed measurements.

The E1433B module converts data into information in four domains: time, frequency, revolution, and order. Digitized data can be simple time records, or the E1433B can use the on-board DSP to compute FFTs and power spectrums to provide data in the frequency domain. Also, for rotating machinery analysis, this module can measure amplitude as a function of shaft angle, or as multiples of the shaft RPM using order ratio spectrums. Since all these measurements are built into the module, no user programming of complex algorithms is required!

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

High-Performance Architecture

The key to high system performance is parallel processing of data. By computing measurement results directly in the digitizer, the E1433B prevents the host computer from being a performance bottleneck. Adding more E1433B's to a system also adds more DSP processing, maintaining system performance even for extremely large systems.

Key E1433B Features

Here are some of the E1433B's other significant features:

- Grounded or differential inputs
- Digital anti-alias filters
- Phase-matched programmable 12 dB/octave high-pass filters
- Continuously computed peak and RMS amplitude of time waveform
- A, B, and C weighting
- Simultaneous sample and hold
- Zoom (non-zero start frequency)
- 8 delta-sigma ADC's

Signal Conditioning is Built-in

Four different breakout boxes provide remote connections to voltage, IEPE accelerometers, microphones, and piezoelectric transducers. By putting transducer signal conditioning in the interchangeable breakout boxes, the E1433B can support mixed transducer types. To change test transducers, just change the breakout boxes.

Exceptionally Fast Data Capture

The standard 32 MB RAM FIFO in the E1433B provides 16 Msamples of data storage for capturing long transient signals. If 16 Msamples is not enough, you can throughput the data to an Agilent N2216A VXI/SCSI Interface Module. The N2216A can transfer data at a 15 MB-per-second rate to an external SCSI device or to the optional internal hard drives (one 50 GB drive or two 50 GB drives). To make sure the data is valid, it may be monitored during throughput. The host can "eavesdrop" on the data as it is passed to the N2216A, displaying time data or FFT results.

Optional Source for Stimulus

A 16-bit arbitrary source can be added to provide sine, burst sine, swept sine, random, burst random, and arbitrary waveform stimulus for testing structures or devices. Since it does not take up extra slots, it saves money and space. It has a constant output level amplifier (COLA) for signal monitoring, a summing junction for adding the outputs of multiple sources, and a programmable ramp-down rate.

Optional Dual Tachometer Input

For testing rotating machinery the E1433B has an optional dual tachometer input. It tags acquired data with the actual RPM when the data was taken. It also can trigger data acquisitions at specified RPM intervals between specified start and stop RPMs.

Backplane Connector Shielding

To ensure compliance with RFI levels specified in standards EN55001 and CISPR11, this product requires the backplane connector shields installed in an Agilent VXI C-size mainframe.

Option 918 is available with the purchase of a new mainframe; accessories, Agilent P/Ns E1400-80920, E1421-80920, and E8400-80918 (one kit per mainframe) are available for retrofitting existing Agilent mainframes E1401A/B, E1421B, and E84XXA, respectively.

For More Information

E1432A, E1433B, E1434A VXI Digitizer/Source Product Overview, pub. no: 5968-7086E;

E1433B Technical Specifications, pub. no.: 5968-8730E;

E3242A Product Overview, pub. no.: 5966-3060E;

E3243A Product Overview, pub. no.: 5966-3061E.

Product Specifications

General

Number of channels:	8
Bandwidth:	88 kHz
Alias protection:	Anti-Aliasing Filter built-in
Timebase resolution:	5 μ s
Low-frequency CMRR:	70 dB
Variable bandwidth:	Yes
2 dB input range headroom:	Yes
Pre-arm capture:	Yes
Dual-rate sampling:	No

(Agilent E1433B continued)

Frequency		
Sample rates:	196 kSa/s to 0.146483 Sa/s (internal clock)	
Alias protected frequency spans:	88 kHz to 0.4 Hz	
Maximum zoom span:	10 kHz	
Maximum zoom center frequency:	10 kHz	
Input		
Full scale input ranges:	5 mVpk to 10 Vpk (1, 2, 5 steps)	
Input impedance:		
Differential:	2 M Ω	
Grounded:	1 M Ω	
12 dB/oct highpass filter:	Programmable from 1.0 to 100 Hz	
Common mode rejection ratio:	>70 dB, 10 Hz to 1 kHz	
Amplitude		
Basic accuracy:	0.5%	
Amplitude accuracy at 1 kHz:	$\pm 0.5\%$ (± 0.043 dB) $\pm 0.01\%$ of full scale	
Flatness relative to 1 kHz:	$\pm 2\%$ (± 0.17 dB)	
Cross Channel Matching (any E1433B module in the same mainframe)		
Cross channel amplitude match (full-scale signal, input ranges equal):		
Up to 29 kHz:	± 0.1 dB	
29 kHz to 88 kHz:	± 0.2 dB	
Cross channel phase match (full-scale signal, input ranges equal).ac coupled (freq >2x ac HPF corner freq):		
To 750 Hz:	$\pm 0.9^\circ$	
750 Hz to 88 kHz:	$\pm (f/22000)^\circ$	
Cross channel phase match (full-scale signal, input ranges equal).dc coupled:		
10 Hz to 88 kHz:	$\pm (f/22000)^\circ$	
At 1 kHz:	$\pm 0.045^\circ$	
Cross-mainframe time delay:	70 ns delay typ. + 6 ns/m of cable	
Dynamic Range		
Resolution:	16 bits	
Distortion:		
above 65536 Sa/sec:	-90 dBfs typ.	
≤ 1.2 kSa/sec:	-74 dBfs	
Input noise level (above 100 Hz):	70 nVrms/ $\sqrt{\text{Hz}}$	
Input channel RAM buffer size (split evenly over active channels):	32 MB (16 MSamples)	
Dual-ported memory:	Yes	
Segmented memory:	No	
Data Transfer Rates		
Up to 1.568 Msamples per second per module, depending on I/O and computer being used. Refer to <i>E1433B Technical Specifications</i> , Pub No. 5968-8730E.		
Triggering Types		
Input, external, source, software, TTL TRG, RPM (requires AYF option). E1432A/33B/34A sample rates and triggering can be synchronized across multiple modules and mainframes.		
Trigger:	Next sample	
Maximum trigger delay:		
Note: 8 channels active		
	4 MB RAM	32 MB RAM
Pre trigger:	262 kSa	2 MSa
Post trigger:	16 MSa	16 MSa

DSP Measurement Results

Built-in DSP:	Yes
Time domain:	Time, peak and RMS amplitude
Frequency domain:	Windowed FFT, power spectrum
Revolution domain:	Sample at tach times
Order domain:	RPM triggered order ratio spectrums
Window types:	Uniform, Hann, Flattop
Averaging types:	RMS, linear, exponential, peak hold
Lines of resolution:	
Frequency domain:	50 to 3,200
Order domain:	50 to 1,600

Signal Conditioning

8-Channel voltage breakout box:	8 BNC connectors
8-Channel voltage/IEPE breakout box:	8 BNC connectors with switchable voltage/IEPE
IEPE current:	4 mA
Open circuit voltage:	24 V
4-Channel mic/voltage/IEPE breakout box:	4 channels with LEMO connectors
	0/200 V polarization voltage
	28 V preamp power
	4 BNCs with switchable IEPE/voltage
	4 channels with microdot connector
	4 BNCs with switchable IEPE/voltage

4-Channel charge/voltage/IEPE breakout box:**Optional Arbitrary Source**

Output:	
Full-scale ranges:	10 V to 80 mV
Output impedance:	<0.5 Ω typical
Output modes:	
Sine:	Continuous, burst, swept
Random:	Pseudo, periodic, burst, mooz
Arbitrary output:	Continuous, loop
Sine frequency range:	
Frequency range:	0 to 25.6 kHz
Frequency resolution:	244 μHz
Random noise bandwidth:	
Frequency spans:	25.6 kHz to 0.4 Hz
Mooz spans:	2 kHz to 156 mHz
Mooz center frequency:	<4 kHz
Arbitrary output signal bandwidth:	
20 bit:	6.4 kHz
16 bit:	25.6 kHz
Arbitrary output dual buffer size:	40,960 samples/buffer

Optional Dual Tachometer Input

Maximum input voltage:	± 25 V
Maximum tach pulses/sec:	
Max pulse rate:	100 kHz
Max pulses/rev:	65,535

General Specifications**VXI Characteristics**

VXI device type:	Register based
Data transfer bus:	A16, A32, D32 slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	No
VXI buses:	Local Bus A-row (left)
	Local Bus C-row (right)
	TTL Trigger Bus

(Agilent E1433B continued)

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	No
Command module firmware rev:	n/a
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	C-SCPI not required, C libraries included
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	Yes

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	6.24	0.2
+12 V:	0.75	0.02
-12 V:	0.23	0.01
+24 V:	0.74	0.01
-24 V:	0.51	0.01
-5.2 V:	0.95	0.02
-2 V:	0.03	0.01

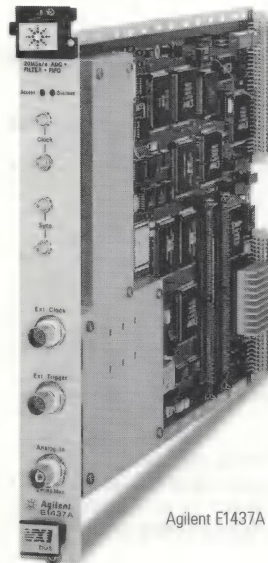
Cooling/Slot

Watts/slot:	60.46
ΔP mm H ₂ O:	0.32
Air Flow liter/s:	4.30

Ordering Information

Description	Product No.
8-Channel 196 kSa/sec Digitizer plus DSP	E1433B
Delete Manual Set	E1433B 0B0
Add Manual Set	E1433B 0B1
Mil std 45662A Calibration w/Test Data	E1433B 1BP
Arbitrary Source	E1433B 1D4
Delete 4 Input Channels	E1433B 1DL
Voltage Input Breakout Box	E1433B AFV
ICP/Voltage Input Breakout Box	E1433B AFW
Charge/ICP/Voltage/Input Breakout Box	E3242A
Microphone/ICP/Voltage Input Breakout Box	E3243A
Add Tachometer Input	E1433B AYF
Add Local Bus Interface	E1433B UGV
Commercial Cal. Certificate w/Test Data	E1433B UK6
3 yr. retn. to Agilent to 1 yr. OnSite Warr.	E1433B W01
Backplane Connector Shield Kit	E1400-80920
VXI Backplane Connector Shield Kit for 6-Slot Mainframe (if ordered separately)	E1421-80920
Backplane Connector Shields Kit	E8400-80918

Publication No.: 5968-8730E

20 MSa/s ADC with Filters and Memory**Agilent E1437A**

Agilent E1437A

- 18-bit (–110 dBfs) spurious free dynamic range
- Alias protection and signal conditioning
- Frequency tunable digital filters
- 8 MB FIFO memory (64 MB optional)
- Flexible triggering and synchronization
- Local bus data rates up to 60 MB/sec

Description

The Agilent Technologies E1437A 20 MSa/s ADC, a C-size, 1-slot, message-based VXI module, is more than just a digitizer, it is a complete ADC module. Included with it is a low-distortion, low-noise digitizer, flexible input signal conditioning, frequency tunable digital filters and a FIFO type memory.

The digitizer in the E1437A provides 23 bits of resolution with up to 18 bits (110 dBfs) of spur and distortion free dynamic range. That means high-quality data that will enhance your analysis results. Its input is fully alias protected enabling data efficient Nyquist sampling. It also has multiple digital filters and a digital LO. Use these filters to reduce the noise in your data and single out signals for specific analysis.

Adjust the E1437A to your signal's magnitude with 11 attenuation/gain ranges and ac/dc coupling. Capture transient signals in the 8 MB FIFO memory (32 MB and 64 MB optional). Use this memory to assemble the output data stream into data blocks, the format most DSP algorithms prefer. Select one of five ways to trigger the E1437A to help assure your measurement starts at exactly the right time. Use the external clock and synchronization features for phase coherent sampling using multiple E1437As.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

- 18 bit (–110 dBfs) spurious free dynamic range

The digitizer used in E1437A is a two-pass (or sub-ranging) type that provides 23 bits of raw resolution. It uses a combination of dithering and an extraordinary on-the-fly distortion correction technique to produce up to 18 bits (–110 dBfs) of distortion free dynamic range.

Not only is the E1437A digitizer low distortion, it is also low noise. Noise density is –140 dBfs/Hz, which, on the lowest input range results in a 16 dB noise figure.

- Alias protection and signal conditioning

The E1437A has a switchable, 8 MHz input alias protection filter to assure data efficient Nyquist sampling.

Full input signal conditioning makes it easy to match the E1437A operating point to your signal amplitude while protecting the digitizer from harmful over-voltages. ac/dc coupling, and 11 attenuation/gain ranges mean you can digitize signals as high as 10.24 Vpk, with or without dc offsets. And a "pseudo-floating" input feature breaks up signal contaminating ground loops.

(Agilent E1437A continued)**• Frequency tunable digital filters**

Sometimes you need to narrow in on a signal to exclude unwanted signals or noise. The E1437A features multiple digital decimating filters, and a digital LO.

Filter bandwidths range from 8 MHz to <1 Hz, in octave steps. After the data is filtered, it is decimated, reducing the effective sample rate, and the amount of memory required to store it, while maintaining alias-protected Nyquist sampling.

Tune the digital LO to center any of the digital filters on your signal to maximize rejection of unwanted signals. The action of the LO on the signal also produces I and Q data, ideal for algorithmic processes that need complex data to compute successfully.

• 8/16/32/64 MB FIFO

The E1437A comes standard with an 8 MB FIFO type memory. You can increase the size of this memory to 64 MB. It can act as a signal capture memory. It can hold 1.6 ms of data (16 bit mode, 20MSa/s sample rate, 64 MB).

Signal processing algorithms, like the Fast Fourier Transform, process data in block rather than as a uninterrupted stream. The E1437A FIFO memory can automatically assemble output data in blocks. And the FIFO design ensures new data will not be lost while a data block is being transferred out.

• Internal and External Clock

You have a choice of sample clocks with the E1437A. The module comes standard with 20 MHz and 20.48 MHz clocks. Select the 20 MHz clock for convenient time domain sampling, use the 20.48 MHz clock for frequency domain sampling. The E1437A can run on an external 10 MHz reference as well.

• Flexible triggering and synchronization

Select one of five ways to trigger the E1437A. Use immediate mode to begin sampling automatically. Select the *external trigger* mode when sampling must start coincident with an external event. Use level mode to trigger on the level of the input signal. Use log magnitude mode to trigger on the magnitude of the signal after it has gone through the digital filters.

Large pre- and post-trigger delays (>1 MSample) are standard and the external trigger modes support slope selection.

Synchronize sampling and digital filtering between modules by connecting the ECL synchronization and clock ports between modules. Less than 10 ns timing skew is maintained within a mainframe.

• Local bus data rates up to 60 MB/sec

Sample linearity and signal processing features are wasted if the data stream has gaps because the module output ports can no keep up with the data digitizing rate. The E1437A provides two ports to move data to other VXI modules.

The VXIbus port on the P1 connector will pass data at >1 MB/s, typical. This is sufficient for continuous sampling of signals with bandwidths below 250 kHz.

For wider signal bandwidths, or multi-channel applications, the Local Bus is key. Using this port the E1437A can achieve 60 MB/s data rates, sufficient for continuous sampling of 8 MHz signal bandwidths.

• VXIplug&play compatible

The E1437A is shipped with software and documentation to support a broad set of controllers, I/O interfaces, programming languages and operating systems. It is fully VXIplug&play compliant and is easily controlled in Win 3.1, Win NT, and Win 95 frameworks.

For More Information

E1437A 20 MSample/second ADC with filter and FIFO Product Overview, pub. no.: 5965-6893E; E1437A Technical Specifications, pub. no.: 5965-9774E.

Product Specifications**Analog Input**

Range (in 6 dB steps):	+ 30 dBm to -24 dBm
Input impedance:	50 W, (>40 dB return loss, f < 8 MHz, dc coupled, BNC shell grounded)

Module Current

	I _{PM}	I _{DM}
+5 V:	5.0	0.50
+12 V:	1.0	0.050
-12 V:	1.2	0.050
+24 V:	0	0
-24 V:	0	0
-5.2 V:	5.0	0.50
-2 V:	0.3	0.10

Accuracy

Basic accuracy:	± 0.03 dB (relative to 12 dBm range)
Absolute voltage measurement:	± 0.03 dB (dc coupled, f < 100 kHz, decimation filters off, 1 V range, 25° C, analog anti-alias filter on)
Range accuracy:	± 0.03 dB (relative to 12 dBm range for all ranges, f < 100 kHz, decimation filters off, dc coupled, 25° C)
Temperature accuracy:	< 0.001 dB per° C of deviation from 25° C (f < 100 kHz, decimation filters off, dc coupled)

Dynamic Range

Resolution:	23 bits
Harmonic distortion:	< -110 dBfs or -75 dBc, whichever is greater
Spurious signals:	< -110 dBfs, using internal clock (includes alias products, 2 kHz to 8 MHz, terminated with 50 W at input connector)

Clock

ADC clock sources:	Internal, external BNC input compatible with TTL, ECL, and > -6 dBm sine waves
Internal ADC clock frequency:	20 MHz and 20.48 MHz
ADC clock accuracy:	± 100 Hz (internal 20 MHz, 0 to 40° C)

Trigger

Sources:	External TTL/ECL/sine wave with ± slope select, ADC output, signal magnitude, software initiated, immediate
Trigger delay:	Yes, pre- and post-
Trigger:	On event

Filtering

Analog anti-alias filter:	8 MHz, switchable
Digital filters	0.48 Hz to 4 MHz, octave steps
Digital LO:	Tunes the center frequency of any digital filter between dc and 8 MHz (less half the filter width) with 20 mHz resolution.

Memory

Size:	8 MB, 16 MB (opt UFC), 32 MB (opt ANC), 64 MB (opt ANE)
Type:	FIFO

Programming

Output data format:	16 bit real, 32 bit real, 16 bit complex, 32 bit complex
Data output modes:	VME data transfers, Local bus data transfers
Measurement modes:	Block, continuous
Data interrupt:	Two independent priority interrupts initiated by masked status bits

(Agilent E1437A continued)

General Specifications

VXI Characteristics

VXI device type:	Message/register based
Data transfer bus:	A16, D16
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	Local Bus A-row (left) Local Bus C-row (right) ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

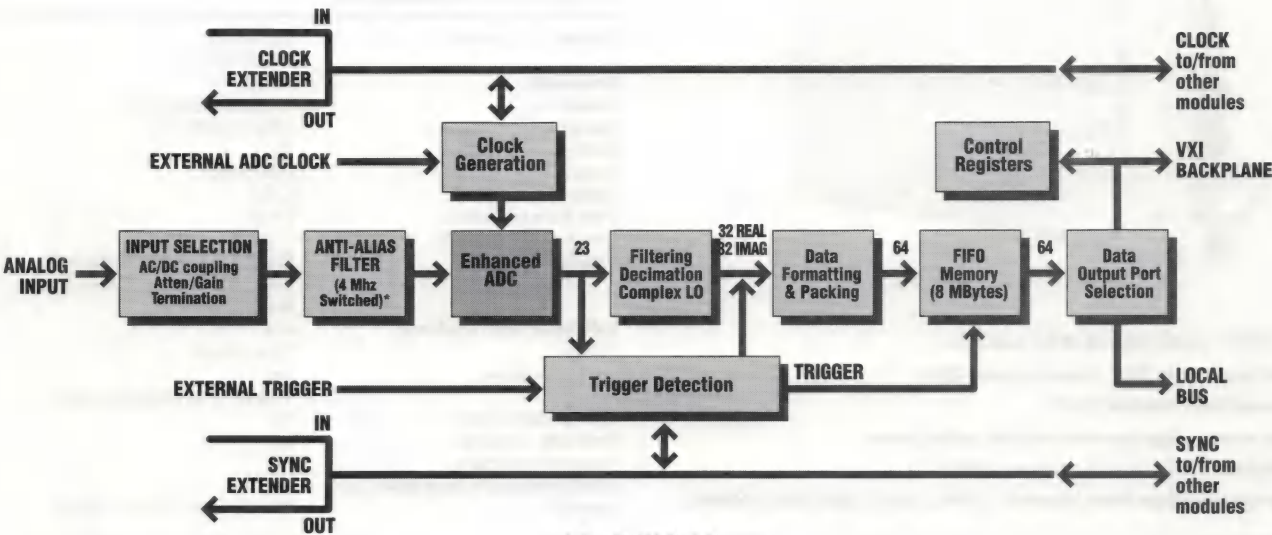
Command module firmware:	n/a
Command module firmware rev:	n/a
I-SCPI Win 3.1:	n/a
I-SCPI Series 700:	n/a
C-SCPI LynxOS:	No
C-SCPI Series 700:	n/a
Panel Drivers:	No
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	Yes

Cooling/Slot

Watts/slot:	77
ΔP mm H ₂ O:	0.5
Air flow liter/s:	4.0 (15° C rise)

Ordering Information

Description	Product No.
20 MSa/s Digitizer with Filters and Memory	E1437A
Service Manual	E1437A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1437A W01



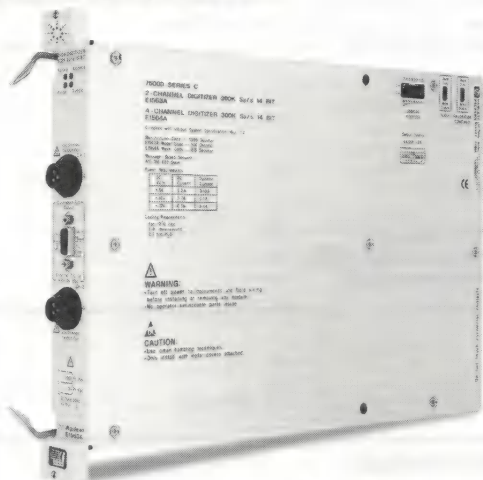
*8 Mhz for E1437A

Agilent E1437A Block Diagram

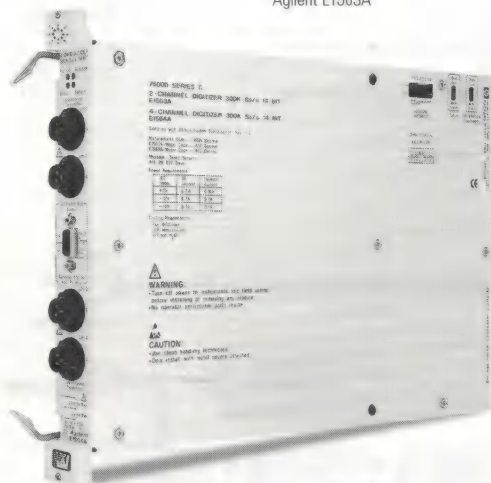
Publication No.: 5965-9774E

800 kSa/s, 2- and 4-Channel Digitizers

Agilent E1563A, E1564A



Agilent E1563A



Agilent E1564A

- 800 kSa/s sample rate with 14-bit resolution
- Input ranges up to 256 V, channel isolation 256 V
- Common mode rejection 113 dB
- Time or event triggering with selectable reading counts
- Switchable 25 kHz input filter/channel (E1563A)
- Four selectable input filters/channel—1.5 kHz, 6 kHz, 25 kHz, 100 kHz (E1564A)

Accuracy

Range:	Zero Offset ¹ (with filter OFF)		Zero Offset ¹ (with filter ON)		Gain (% of reading)		Noise (3 sigma)
	Specifi- cation ²	Temperature Coefficient ³	Specifi- cation ²	Temperature Coefficient ³	Specifi- cation ²	Temperature Coefficient ³	Specifi- cation ²
0.0625 V	20 μ V	1.9 μ V/°C	28 μ V	4.3 μ V/°C	0.034%	0.0061%/°C	57 μ V
0.25 V	78 μ V	6 μ V/°C	110 μ V	16 μ V/°C	0.034%	0.0061%/°C	180 μ V
1 V	300 μ V	15 μ V/°C	430 μ V	63 μ V/°C	0.034%	0.0061%/°C	720 μ V
4 V	1.2 mV	60 μ V/°C	1.7 mV	251 μ V/°C	0.034%	0.0061%/°C	2.88 mV
16 V	21 mV	1.3 mV/°C	21 mV	1.63 mV/°C	0.034%	0.0061%/°C	14.7 mV
64 V	28 mV	1.65 mV/°C	34 mV	4.24 mV/°C	0.034%	0.0061%/°C	48 mV
256 V	79 mV	4.28 mV/°C	110 mV	16.2 mV/°C	0.034%	0.0061%/°C	189 mV

¹Valid within the range of 0° C to 55° C. A zero offset calibration for all channels must be performed if the instrument experiences a temperature <0° C or >55° C for these specifications to remain valid.

²Specification is valid when tested at a temperature within $\pm 5^\circ$ C of the calibration temperature.

³Amount of error that must be added for each° C outside of $\pm 5^\circ$ C of the calibration temperature.

Description

The Agilent Technologies E1563A and E1564A digitizers are C-size, 1-slot, register-based VXI modules. They are ideal for measurements in electronic production test and electromechanical design characterization, particularly in environments with high levels of electrical noise. Engineers and technicians in manufacturing test, product development, and engineering research test groups can fully characterize electronic and mechanical transient waveforms with these highly accurate digitizers.

Each channel of the digitizers has its own analog electronics, including 800 kSa/s 14-bit A/D converters, and independent channel isolation. The E1563A channels have switchable 25 kHz input filters, and the E1564A channels have four (4) selectable input filters.

The digitizers are configured for PC SIMM memory, scalable from 4 Mbytes to 64 Mbytes. The large memory can easily capture transients and act as a FIFO to allow continuous digitizing while unloading data with block mode transfers.

Time Base and Triggering

All channels sample simultaneously with a single internal or external time base. Triggering can be set up for either time or event modes with programmable pre- and post-trigger reading counts.

Programming

The E1563A and E1564A both have a simple programming model which includes a data FIFO or flat file memory model for the A/D converter, 16-bit integer data corrected for offset and gain errors, and a current value table to retrieve the current sample of data.

Calibration

The E1564A provides a calibration source with flash ROM for holding calibration constants.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Number of channels:	2 (E1563A) 4 (E1564A)
Bandwidth:	1 MHz
Resolution:	14 bits (including sign)
Sample rates:	1 Sa/s to 800 kSa/s
Built-in DSP:	No
Alias protection:	Oversample
Basic accuracy:	0.1%
Time Base resolution:	0.1 μ s
Low-frequency CMRR:	113 dB
Variable bandwidth:	E1563A: 25 kHz switchable filter E1564A: 4 selectable filters, 2-pole linear phase
2 dB Input range headroom:	n/a
Trigger:	Time & Event
Pre-arm capture:	Yes
Memory:	4 Mbyte to 64 Mbyte PC SIMM
Dual-ported memory:	Yes
Dual-rate sampling:	No
Segmented memory:	No
E1564A selectable input filters (per channel):	1.5 kHz, 6 kHz, 25 kHz, 100 kHz

(Agilent E1563A, E1564A continued)

Integral Non-Linearity Specification

All ranges: 2.5 LSB

Environmental Specifications

For indoor use: Pollution degree 2
 Operating altitude: 3000 meters or mainframe altitude specification, whichever is lower
 Operating temperature: 0° C to 55° C
 Relative humidity: Up to 80% at 31° C, decreasing to 50% at 40° C

General Specifications**VXI Characteristics**

VXI device type: Register based
 Data transfer bus: A16, slave only
 Size: C
 Slots: 1
 Connectors: P1/2
 Shared memory: None
 VXI buses: TTL

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable
 Command module firmware rev: A.01.00
 I-SCPI Win 3.1: No
 I-SCPI Series 700: No
 C-SCPI LynxOS: No
 C-SCPI Series 700: No
 Panel Drivers: No
 VXIplug&play Win Framework: No
 VXIplug&play Win 95/NT Framework: Yes
 VXIplug&play HP-UX Framework: No

Note: The Agilent VEE application can use VXIplug&play drivers or panel drivers.

Cooling/Slot

Watts/slot: E1563A: 20.6
 E1564A: 37.4
 ΔP mm H₂O: 0.18
 Air flow liter/s: 2.8

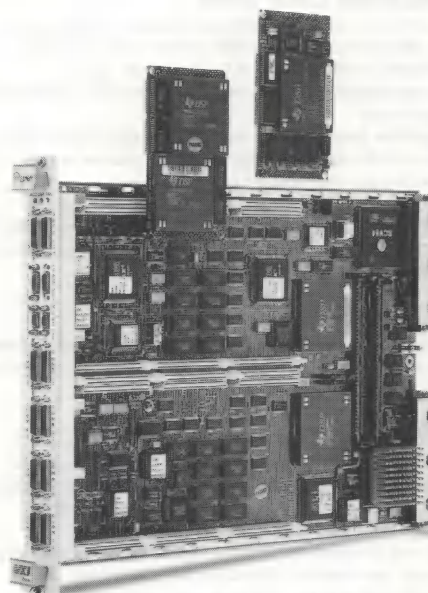
Module Current

	E1563A		E1564A	
	I _{PM} (A)	I _{DM} (A)	I _{PM} (A)	I _{DM} (A)
+5 V:	1.1	0.5	1.1	0.5
+12 V:	0.6	0.1	1.2	0.1
-12 V:	0.6	0.1	1.2	0.1
+24 V:	0	0.01	0.05	0.01
-24 V:	0	0.01	0.05	0.01
-5.2 V:	0.1	0.01	0.01	0.01
-2 V:	0.1	0.01	0.01	0.01

Ordering Information

Description	Product No.
800 kSa/s 2-Channel VXI Digitizer	E1563A
Add Manual Set	E1563A 0B1
Convert Standard Warranty to On-site	E1563A W01
800 kSa/s, 4-Channel VXI Digitizer	E1564A
Add Manual Set	E1564A 0B1
Convert Standard Warranty to On-site	E1564A W01

Publication No.: 5988-2341EN

TI-Based VXI DSP Module**Agilent SCMVX008 (Distributed Product)**

Agilent SCMVX008

- Up to eight DSPs (60 MHz, TI TMS320C40)
- Six TIM-40 mezzanine card slots
- 4 to 64 MB VXI shared RAM
- A selection of high-performance data ports
- Local bus support
- Program with standard C40 tools

Description

The Agilent Technologies SCMVX008 Digital Signal Processor is a C-size, 1-slot, register-based VXI module. This module features two Texas Instruments TMS320C40 DSPs, plus six slots for adding as many as 12 more DSPs, a selection of high-speed data ports, up to 64 MB of shared RAM, and standard C40 tools for software development.

TI's TMS320C40 is a 32-bit, floating-point, general purpose processor capable of computing a 1 k, complex FFT in under 2 ms. The two C40s on the SCMVX008 are ideal for application in communications, signal analysis, process control, data acquisition, and test. If two DSPs are not enough you can add more. The six TIM-40 mezzanine card slots in the SCMVX008 can hold six C40s (Opt 011) or twelve C44 DSPs (Opt 012). The C44 is a DSP similar to the C40.

Processing power is wasted without high-speed data I/O ports. The SCMVX008's selection of high-performance ports includes: a VXIbus port, a Local bus port, eight front panel C40 comm ports, and two general purpose application-specific connector ports.

Use TI's proven, mature TMS320 software development tool set to develop code for the SCMVX008.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Up to Eight DSPs (TI TMS320C40, 60 MHz)

When your data acquisition or signal processing tasks demand concentrated computing power the SCMVX008 is the answer. This module offers two of Texas Instrument's high performance 60 MHz TMS320C40 digital signal processors. One of the most popular processors in the world, these 32-bit resolution, general purpose, floating point DSPs are ideal for application in communications, signal analysis, process control, data acquisition, and test.

(Agilent SCM VX008 continued)

Six TIM-40 Mezzanine Card Slots

Increase the compute power in your SCM VX008 by using its six expansion slots to add processors. Each slot can hold a TIM-40 type mezzanine card. Different cards have different combinations of DSP, memory and I/O capabilities. By mixing and matching TIM-40 cards you can build a processing system to suit your application.

The SCM VX008 offers three TIM-40 cards options. Option 011 holds a single 60 MHz C40. Option 012 holds two C44 DSPs, a DSP similar to the C40. Option 040 offers a four-channel digital down converter.

The TIM-40 based E2748 Vector Waveform Generator module also plugs into the SCM VX008. This real-time DSP DAC card calculates complex (I/Q) communication signal waveforms for you in real time. See the product page for the E2748 for more information.

4 to 64 MB VXI Shared RAM

VXI shared memory facilitates data transfer to the host or other VXI modules over the VXIbus. Order as much as your processing needs demand. Select as little as 4 MB (Opt 082), or as much as 64 MB (Opt 085).

A Selection of High Performance Data Ports.

The SCM VX008 module has a selection of data ports to assure fast input of raw data and efficient output of processed data. The VXI local bus port offers the fastest data transfer to and from other VXI modules. The SCM VX008 achieves 60 MB/s input rates via the VXI local bus port.

Use the VXIbus port to transfer processed data to the host or to other VXI modules. Data transfer rates on this shared bus are about 2 MB/s, typical. Share data directly with external C40 comm port compatible resources via the eight C40 comm ports on the module front panel. Typical data rates for these ports are 15 MB/sec each.

Standard C40 Software Development

Develop software for the SCM VX008 using standard C40 software tools. TI's C4x Assembler/Linker and ANSI C compiler are available on PC's and HP-UX workstations, enabling users to develop DSP applications in the environment they are comfortable in. Download prototype code via standard JTAG connectors. The SCM VX008 supports full JTAG functionality including interrupts and single-step execution.

Host-to-DSP communication is supported with a complete VXI I/O library (part of the SCM4008 I/O library and JTAG kit) that runs on either SICL or VISA. The library is HP-UX, Windows NT, and Windows 95 compatible.

Backplane Connector Shielding

To ensure compliance with RFI levels specified in standards EN55001 and CISPR11, this product requires the backplane connector shields installed in an Agilent VXI C-size mainframe.

Option 918 is available with the purchase of a new mainframe; accessories, Agilent P/Ns E1400-80920, E1421-80920, and E8400-80918 (one kit per mainframe) are available for retrofitting existing Agilent mainframes E1401A/B, E1421B, and E84XXA, respectively.

For More Information

SCMVX008 TI-Based VXI DSP Module Product Overview, Pub. No.: 5966-3438E;

SCMVX008 Technical Specifications, Pub. No. 5966-3437E.

General Specifications**VXI Characteristics**

VXI device type:	Register based
Data transfer bus:	A16/A32 - D64/D32/D16/D08
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	4, 8, 32, 64 MB
VXI buses:	Local Bus A-row (left), Local Bus C-row (right), TTL Trigger Bus, ECL Trigger Bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	None
Command module firmware rev:	None
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	Yes

Cooling/Slot

(No TIM-40 modules installed, request technical specification sheet for more information)

Watts/slot:	21.36
ΔP mm H₂O:	0.07
Air Flow liter/s:	1.78

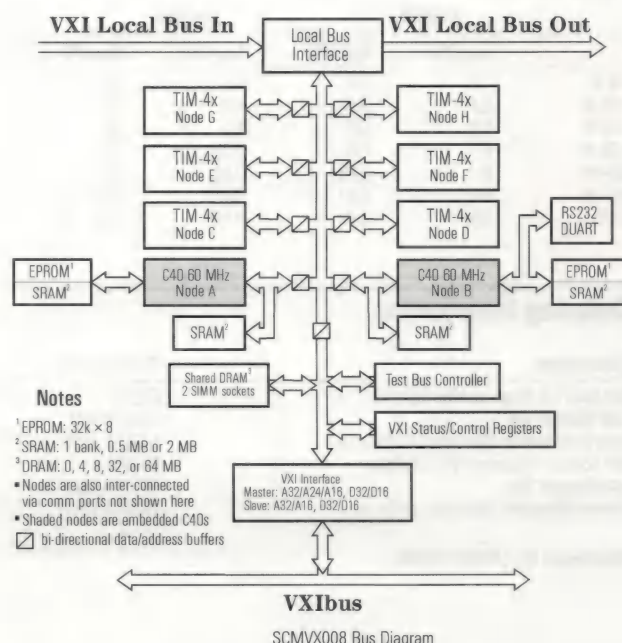
Module Current

(No TIM-40 modules installed, request technical specification sheet for more information)

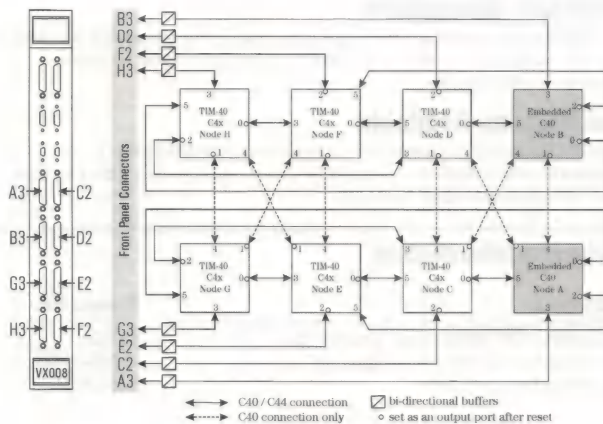
	I_{PM} (A)	I_{DM} (A)
+5 V:	3.44	0.620
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0.737	0.024
-2 V:	0.165	0.007

Ordering Information

Description	Product No.
C-Size VXI DSP module with two 60 MHz TMS320C40 signal processors	SCMVX008
Backplane Connector Shield Kit	E1400-80920
VXI Backplane Connector Shield Kit for 6-Slot Mainframe (if ordered separately)	E1421-80920
Backplane Connector Shields Kit	E8400-80918



(Agilent SCM VX008 continued)



Publication No.: 5966-3437E

4-Channel Charge/Voltage Breakout Box

Agilent E3242A



Agilent E3242A

- Designed specifically for the Agilent E1432A and E1433B
- Four independently programmable channels
- Buffered output for each channel
- BNC and Microdot connectors for input
- Complete signal conditioning in one box

Description

This Breakout Box accessory is specifically designed to interface accelerometers (charge mode and 4 mA constant current power supply) to Agilent Technologies' high-performance E1432A and E1433B VXI Digitizer modules. It integrates four channels of signal conditioning in one box, reducing the count of transducer conditioning equipment needed for both small and large channel-count VXI systems. This unit has two input connector types to match the intended transducer connection, as well as buffered outputs for signal monitoring or recording.

The E3242A is dedicated for use with the E1432A and E1433B only and is specifically designed for mechanical measurements by providing four separately programmable signal conditioning inputs for use with Charge and 4 mA constant current power supply accelerometers. Input connectors for each channel is via a BNC for voltage or 4 mA constant current power supply, and a microdot for Charge mode accelerometers.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Remote Control Features

The E3242A is remote programmable allowing you to setup each channel's parameters through your application software. No longer will you have to manually setup your signal conditioning! Each channel can be programmed for float or grounded input, which connects the BNC shell to chassis ground, or allows for a differential input. The charge amplifier gains can also be programmable and a 2 kHz low-pass filter can be switched in or out.

Configuration and Connectivity Information

The E3242A 4-Channel Charge/Voltage/Breakout Box is available in only one configuration, and is designed for use only with the E1432A and E1433B VXI Digitizer modules. Supplied with the unit is a 2m cable for connecting to an E1432A or an E1433B VXI Digitizer module. Since the E1432A VXI Digitizer module can contain up to 16 channels, it is possible to connect up to four E3242A units per module.

Warranty Information

The E3242A comes with a 3-year warranty. During that period, the unit will either be replaced or repaired, at Agilent's option, and returned to the customer without charge.

Accessories Available

A rack-mount kit is available which will allow two E3242A units to be installed side-by-side into a standard 19" system rack. Order Option AXR for every two units to be rack mounted.

Ordering Information

Description	Product No.
Charge/ICP/Voltage/Input Breakout Box	E3242A
Rack Mount Kit for 2 Breakout Boxes, 19"	E3242A AXR
20m Active Extender Cable	E3242A AFL

Publication No.: 5967-6371E

Product Overview

15

4-Channel Microphone/Voltage Breakout Box

Agilent E3243A



Agilent E3243A

- Designed specifically for the Agilent E1432A and E1433B
- Four independently programmable channels
- Buffered output for each channel
- BNC and 7-pin LEMO connectors for input
- 4 channels of signal conditioning in one box

15

Description

This Breakout Box accessory is specifically designed to interface microphones (as well as voltage and 4 mA constant current power supply accelerometers) to Agilent Technologies' high-performance E1432A and E1433B VXI Digitizer modules. It integrates four channels of signal conditioning in one box, reducing the count of transducer conditioning equipment needed for both small and large channel-count VXI systems. Applications include both acoustic and mechanical measurements. It has two input connector types to match the intended transducer connection, as well as buffered outputs for signal monitoring or recording.

The E3243A is dedicated for use with the E1432A and E1433B only and is designed for acoustic measurements by providing the conditioning necessary for pressure and free field microphones. It also provides conditioning for mechanical measurements where voltage or 4 mA constant current power supply accelerometers are to be used. Input connections for each channel are via BNC for voltage and 4 mA constant current power supply, and a 7-pin LEMO connector for microphones.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Remote Control Features

The E3243A is remote programmable allowing you to setup each channel's parameters through your application software. Each channel can be programmed for float or grounded input which connects the BNC shell to chassis ground, or allows for a differential input. Other programmable functions include gain setting and 4 mA constant current power supply on/off control.

Configuration and Connectivity Information

The E3243A 4-Channel Microphone/Voltage Breakout Box is available in only one configuration, and is designed for use only with the E1432A and E1433B VXI Digitizer modules. Supplied with the unit is a 2m cable for connecting to an E1432A or E1433B VXI Digitizer module. Since the E1432A VXI Digitizer module can contain up to 16 channels, it is possible to connect up to four E3243A units per module.

Warranty Information

The E3243A comes with a 3-year warranty. During that period, the unit will either be replaced or repaired, at Agilent's option, and returned to the customer without charge.

Accessories Available

A rack-mount kit is available which will allow two E3243A units to be installed side-by-side into a standard 19" system rack. Order Option AXR for every two units to be rack mounted.

Ordering Information

Description	Product No.
Microphone/ICP/Voltage Input Breakout Box	E3243A
Rack Mount Kit for 2 Breakout Boxes, 19"	E3243A AXR
20m Active Extender Cable	E3243A AFL

Publication No.: 5968-1102E

**Terminal Panel**

Product No.	Description
E1586A	Rack Mount Terminal Panel for 32 Channels

Terminal Blocks and Connectors

QUIC (Quality Insertion and Connection) Terminal Blocks

Mass Interconnect Solutions and Fixturing Accessories

Product No.	Description
L-2000	MAC Panel Mass Interconnect System
VG Series	TTI Testron VG Series Receivers and Fixtures
VPC 2118	Virginia Panel Gemini Interface System

Introduction

Agilent Technologies offers flexible wiring for your test systems via terminal blocks, using QUIC technology, and via mass interconnect systems. QUIC (QQuality Insertion and Connection) terminal blocks provide easy-in/easy-out levers and guides on the front panel to assure terminal block alignment. It also provides convenient methods of wiring to your applications.

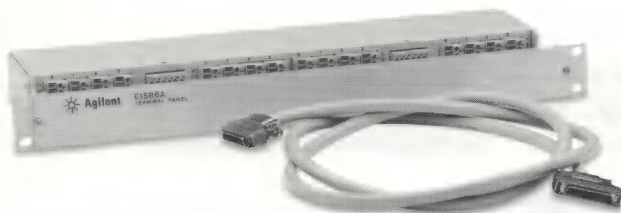
Overview: Interconnect & Wiring Choices

Agilent's multichannel VXI instruments – scanning A/Ds, multiplexers, etc. – are supplied with QUIC terminal blocks that have either screw or spring clamp terminals. Other terminal configurations are optionally available: crimp and insert, solder eye direct to terminal block connector, or ribbon cable direct to terminal block connector. A fourth option is available – terminal block interface – that allows connection to a separate rack cabling product, the Rack Mount Terminal Panel (E1586A).

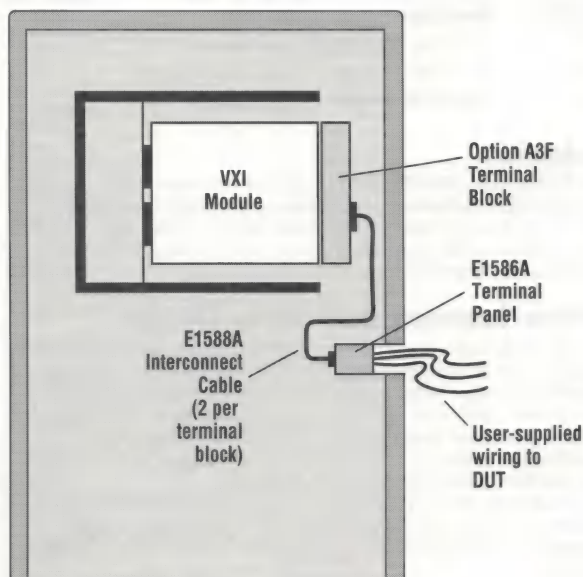
A selection of mass interconnect solutions and fixturing accessories are featured in this section. These products are available directly from the manufacturer: MAC Panel Company, TTI Testron, Inc., and Virginia Panel Corporation.

Rack-Mount Terminal Panel

Agilent E1586A



Agilent E1586A



- 96 terminals (32 three-wire channels)
- Built-in strain relief
- Includes pinouts and easy access to probe points
- Connections via 50-pin SCSI connectors
- Internal reference junction 32 TC channels

Description

The Agilent Technologies E1586A Rack-Mount Terminal Panel provides maximum flexibility in configuring system wiring and interface solutions. It connects VXI test modules to your device under test (DUT) when the system components are located at a distance from your mainframe.

Different cable pairs are available from Agilent for connecting the E1586A Rack-Mount Terminal Panel to VXI modules with option A3F. The standard cables (E1588A) consist of two each 2-meter long, 16-channel, 50 conductor twisted pair SCSI cables with one shield around all 16 pairs. These cables are suitable for relatively short cable runs. Ask your Agilent Sales Representative to contact Agilent's manufacturing division for price and delivery of these custom-length cables.

Temperature Monitoring

The isothermal reference junction in the terminal panel provides an internal reference junction for up to 32 three-wire thermocouple channels. The rack-mount design provides easy access to the thermocouples for control and monitoring of distributed environmental temperatures, temperature control applications, and temperature control in material processing.

Filtering

Optional filter board provides jumper-selectable per channel tri-filar transformers and/or low-pass RF filters. These are generally required in order to get accurate low-level measurements whenever high-frequency common mode noise in the 1 kHz to 1 MHz range is present.

Product Specifications

Model:	E1586A Rack-Mount Terminal Panel
Rack width:	Standard 19 inch
Number of terminals:	96 (32 3-wire channels)
Thermocouple channels:	32 3-wire with isothermal reference junction
Common mode RF filter available:	E1586A Opt 001
VXI-to-terminal panel shielded cables (custom length):	See note with Ordering Information.

Ordering Information

Description	Product No.
Rack-Mount Terminal Panel for 32 Channels	E1586A
Add RF Filters	E1586A 001 ⁽¹⁾
16-channel Shielded Twisted Pair Cable Outer Shield (2 ea, 2 m long)	E1588A ⁽²⁾
16-Channel Shielded Twisted Pair Cable Individually Shielded Pairs	See note below. ⁽³⁾

⁽¹⁾ Filters for large common mode signals (above 5 Vp-p and below 5 kHz) are also available by custom order.

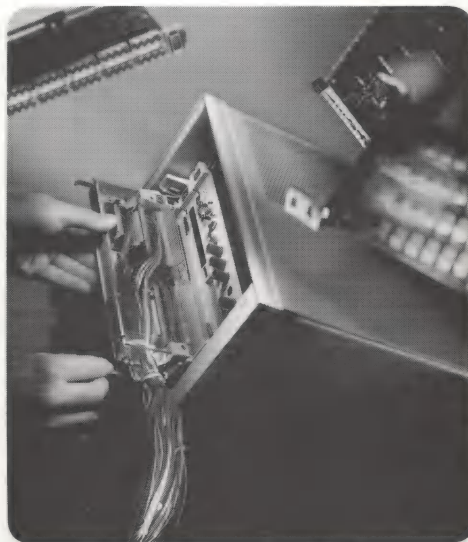
⁽²⁾ A standard SCSI-2 cable (such as the cable orderable from Cables To Go, P/N DZSUNMM3) may be used. Note, however, that the cable must have .050 MD50 connectors on both ends. Agilent strongly recommends using metal connector housings. Molded connector housings may not fit in the terminal modules.

⁽³⁾ These cables can be custom ordered to length to fit your application. To order, ask your Agilent Sales Representative to contact the Agilent manufacturing division for price and delivery.

Publication No.: 5965-5578E

Terminal Blocks

Agilent QUIC



- Convenient wiring to the unit under test
- Levered terminal blocks ease insertion and extraction
- Choice of wiring options

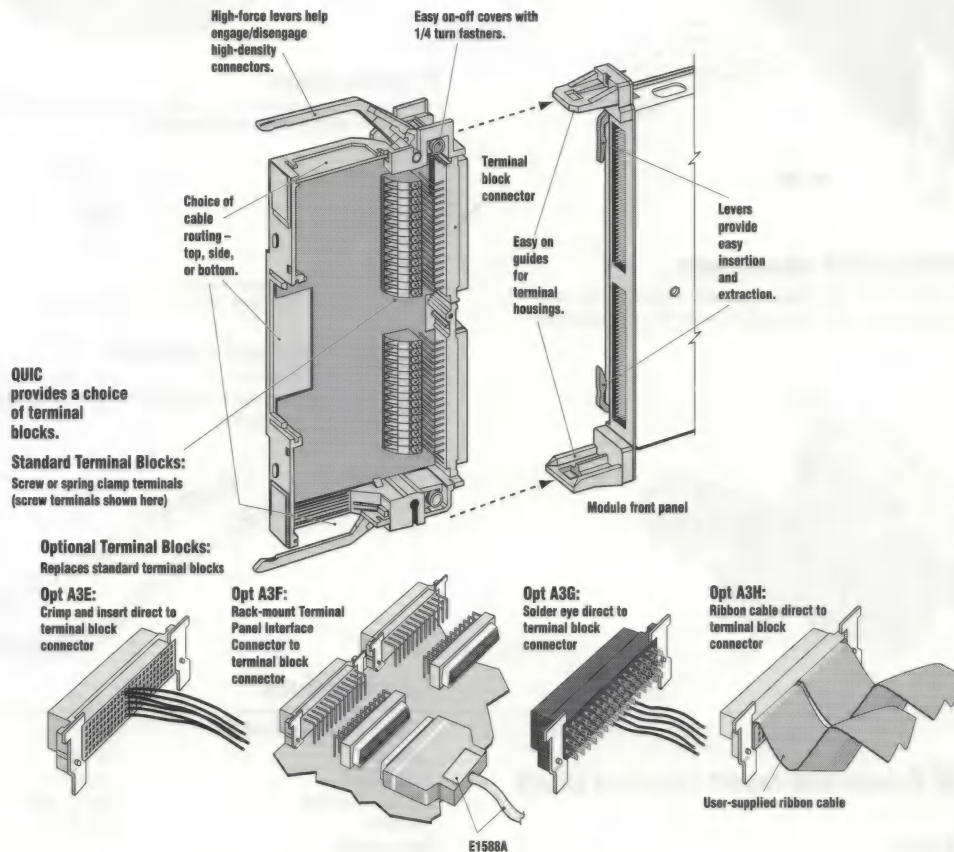
(Agilent QUIC continued)

Description

Agilent Technologies provides terminal blocks standard with all low-frequency multiplexer, matrix, general-purpose switch modules and scanning voltmeters. Several of the C-size modules have terminal blocks which incorporate QUIC (Quality Insertion and Connection). The QUIC terminal block provides you convenient methods of wiring to your application as shown in the accompanying illustration. A terminal block with screw or push-in spring-clamp terminals is provided as standard with QUIC-equipped VXI modules. Also, depending on module type, one or more of the following connector/wiring options to the VXI module may be available.

QUIC also provides easy-in/easy-out levers and guides on the front panel to assure terminal block alignment when attaching the terminal block to the front panel of an instrument/switch module.

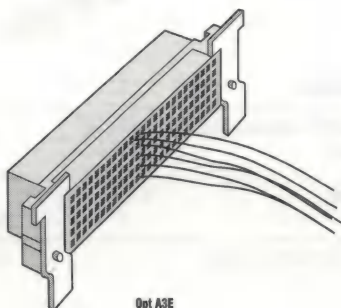
Note: Terminal block housings on QUIC-equipped C-size modules do not fit on older (pre-QUIC) modules and vice versa. Older versions of the terminal blocks (connector housings) will continue to be available for support of existing systems. QUIC ordering information is provided with each Agilent module that supports it.



QUIC is shown with standard screw terminals (spring clamp terminals are standard on some products); Options are available for other connector types.

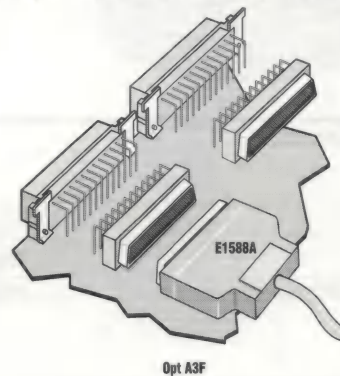
Option A3E: Crimp-and-Insert Connectors

This terminal block option allows you to crimp connectors onto wires which are then in turn inserted directly into the VXI module mating connector. Crimp-and-insert connectors are available separately or precrimped with single conductor or shielded twisted pair cables. See the list of accessories in this document.



Option A3F: Interface to the E1586A Rack Mount Terminal Panel

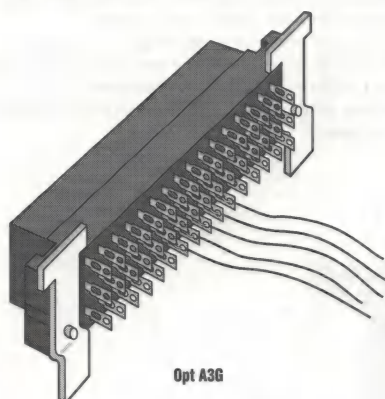
This terminal block option consists of dual 32-pin connectors for signal routing to the E1586A Rack Mount Terminal panel via two each E1588A 16-channel twisted pair cables with outer shield. See the E1586A Data Sheet for details.



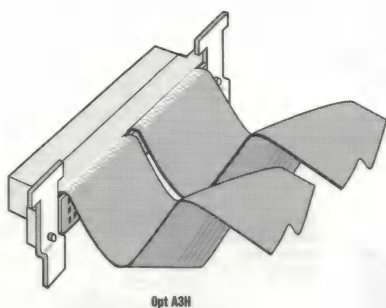
(Agilent QUIC continued)

Option A3G: Solder eye terminals

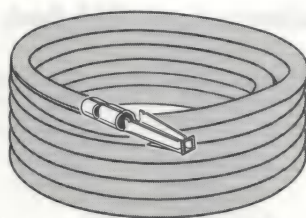
User-supplied wires are soldered directly to the VXI module mating connectors.

**Option A3H: Ribbon cable connectors**

User-supplied 64-conductor ribbon cables are installed directly to the QUIC terminal block mating connector. Only the outer rows of the connector are available.

**QUIC Option A3E Crimp-and-Insert Terminal Block Accessories****Single Conductor and Contact**

A crimp-and-insert contact is crimped onto one end of a wire. The other end is not terminated.

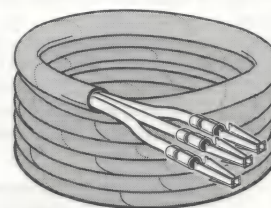
**Specifications****Single Conductor and Contact**

Length:	2 m
Wire gauge:	24 AWG
Insulation rating:	105° C max
Voltage:	300 V

Description	Product No.
Single Conductor Wire and Contact 2 m long (1 each)	8150-5207

Shielded-Twisted Pair and Contacts

A crimp-and-insert contact is crimped onto each conductor at one end of a shielded-twisted-pair cable. The other end is not terminated.

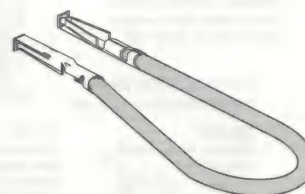
**Specifications****Shielded-Twisted Pair and Contacts**

Length:	2 m
Wire gauge:	24 AWG
Outside diameter:	0.1 in
Insulation rating:	250° C max
Voltage:	600 V

Description	Product No.
Shielded Twisted Pair Wire and Contacts 2 m long (1 each)	8120-6780

Jumper Wire and Contacts

A crimp-and-insert contact is crimped onto each end of a single conductor jumper wire. This jumper is typically used to tie two pins together in a single crimp-and-insert connector.

**Specifications****Jumper Wire and Contacts**

Length:	10 cm
Wire gauge:	24 AWG
Insulation rating:	105° C max
Voltage:	300 V

Description	Product No.
Jumper Wire and Contacts 10 cm	8150-5208

Crimp-and-Insert Contacts

These contacts may be crimped onto a conductor and then inserted into a crimp-and-insert connector. The crimp tool kit is required to crimp the contacts onto a conductor and remove the contact from the connector.

**Specifications****Crimp-and-Insert Contacts (wire not included)**

Wire gauge range:	20-26 AWG
Plating:	Gold plated contact
Maximum current:	2 A at 70° C

Description	Product No.
Crimp-and-Insert Contacts (1 each)	1252-6533

(Agilent QUIC continued)

Crimp-and-Insert Tools

The hand crimp tool is used for crimping contacts onto a conductor. The disassembly tool is required for removing contacts from the crimp-and-insert connector. (No photograph available)

Specifications**Crimp-and-Insert Tools**

Wire gauge range:
Description

20-28 AWG

Product No.

Crimp Tool

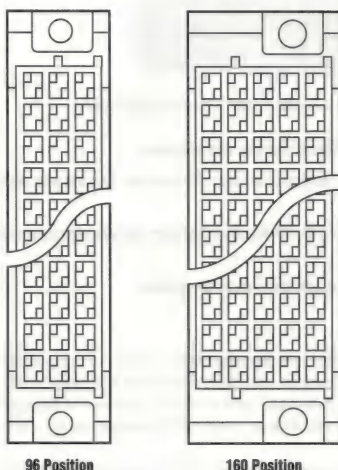
8710-2306

Disassembly Tool

8710-2307

Extra Crimp-and-Insert Connector Housings

These connectors are normally supplied with the crimp-and-insert options of the QUIC terminal blocks.



96 Position

160 Position

Description	Product No.
96 Position Crimp-and-Insert Connector Housing	1252-6532
160 Position Crimp-and-Insert Connector Housing	1252-6531

Note: When using QUIC crimp-and-insert options with the mass interconnect, you must crimp another contact on the unterminated end of the wire. This contact is then inserted into the mass interconnect connector block.

Ordering Information

Description	Part No.
Single Conductor Wire and Contact 2 m long (1 each)	8150-5207
Shielded Twisted Pair Wire and Contacts 2 m long (1 each)	8120-6780
Jumper Wire and Contacts 10 cm	8150-5208
Crimp-and-Insert Contacts (1 each)	1252-6533*
Crimp Tool	8710-2306**
Disassembly Tool	8710-2307**
96 position Crimp-and-Insert Connector Housing	1252-6532***
160 position Crimp-and-Insert Connector Housing	1252-6531***

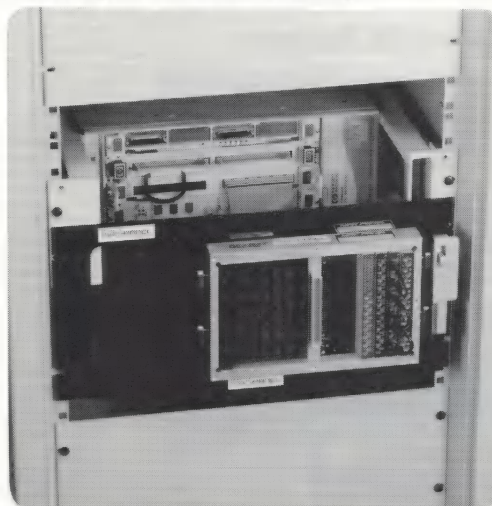
* These Contacts may be ordered direct from the manufacturer as ERNI part number 014728.

** These tools may be ordered direct from the manufacturer as ERNI part numbers 014374 (crimp tool) and 471555 (disassembly tool). For high volume applications, contact ERNI about automated crimp equipment.

*** These connectors may be ordered direct from the manufacturer as ERNI part numbers 024069 (96 position) and 024070 (160 position).

Contact:
ERNI Components, Inc.
12701 North Kingston Avenue
Chester, VA 23836 U.S.A.
(804) 530-5012

Publication No.: Not Available

MAC Panel Mass Interconnect System**L-2000 (Referenced Product)**

MAC Panel L-2000

- Works with Agilent's E84XX Series Mainframes
- Provides full modularity from the ICA (receiver) through the ITA (fixture side) to the DUT (device under test)
- Available in 5-slot, 10-slot and 15-slot configurations
- Can be customized to your configuration needs

Description

The MAC Panel Company offers its L-2000 Series Mass Interconnect System, which provides full modularity from the Interface Connection Adapter (ICA) through the Interface Test Adapter (ITA) out to the Device Under Test (DUT). The L-2000 Series is currently offered in three size configurations: 5 slots, 10 slots, and 15 slots.

The new L-2000 has a full range of connector modules and contacts available. The system will handle low current signal (up to 20 amps), power (up to 50 amps), and high frequency (dc to 40 GHz). The L-2000 works with wireless solutions and PCB solutions. Standard cables and custom cable services are available.

This product is referenced by Agilent Technologies. It is manufactured and sold by MAC Panel Company of High Point, NC. Agilent does not sell, distribute, warrant, or support this product.

For more information contact:

MAC Panel Company
High Point, NC, U.S.A.
Telephone: 336-861-3100
www.macpanel.com

Ordering Information

Description	Product No.
Mass Interconnect System	L-2000

Order from:

MAC Panel Company
P.O. Box 7728
High Point, NC 27264
Telephone: 336-861-3100
Fax: 336-861-6280
www.macpanel.com

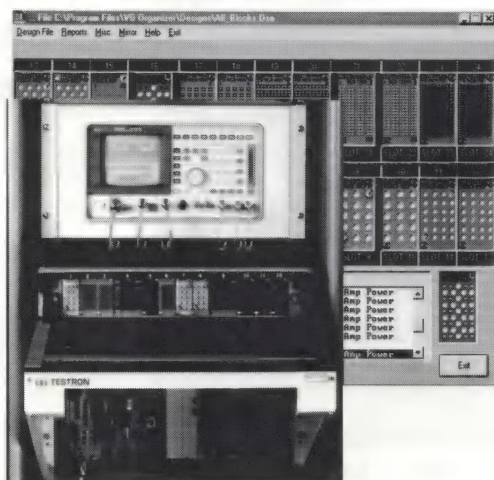
Note: This product cannot be ordered from Agilent Technologies.

Referenced Product

The information for this product has been provided by MAC Panel Company. Agilent Technologies disclaims any and all liabilities for and makes no warranties, expressed or implied, with respect to this product, including without limitation the implied warranties of merchantability and fitness for a particular purpose. Providing information concerning this product does not constitute Agilent's endorsement of this product, MAC Panel Company, or its support services.

TTI Testron VG Series Receivers and Fixtures

VG Series (Referenced Product)



TTI Testron Rack Mount Receiver and VG Organizer®

- Works with Agilent's E84XX Series Mainframes
- Interface, receivers, contact blocks, fixture kits and adapter boxes available

Description

TTI Testron offers its VG Series of products as mass interconnect solutions for discrete interconnects to PCB's or unit-level test systems. The interface termination allows consolidation of up to 24 modules for power, signal, high frequency, fiber-optic vacuum and pneumatic terminations. The VG Organizer® software provides point and click system and test fixture configuration for standardization of VG Series interconnect documentation and test set manufacturing. 4, 12 and 24 module configurations, dc- 40 GHz.

These products are referenced by Agilent Technologies. They are manufactured and sold by TTI Testron, Inc. of Woonsocket, RI. Agilent does not sell, distribute, warrant, or support these products.

For more information contact:

TTI Testron, Inc.
Woonsocket, RI, U.S.A.
Telephone: 401-766-9100
www.ttitestron.com

Ordering Information

Description	Product No.
VG Series Receivers and Fixtures	VG Series

Order from:

TTI Testron, Inc.
41 Century Drive
Woonsocket, RI, 02895
Telephone: 401-766-9100
www.ttitestron.com

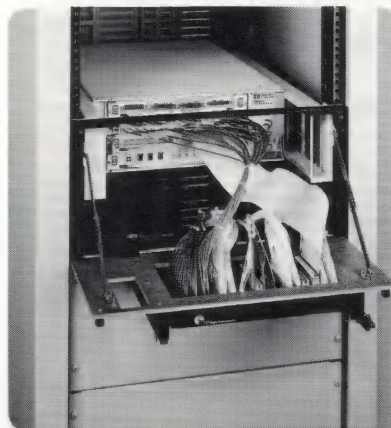
Note: These products cannot be ordered from Agilent Technologies.

Referenced Product

The information for these products has been provided by TTI Testron, Inc. Agilent Technologies disclaims any and all liabilities for and makes no warranties, expressed or implied, with respect to this product, including without limitation the implied warranties of merchantability and fitness for a particular purpose. Providing information concerning this product does not constitute Agilent's endorsement of this product, TTI Testron, Inc., or its support services.

Virginia Panel Gemini Interface System

VPC 2118 (Referenced Product)



VPC 2118/Gemini Interface System with Agilent's E8408A Mainframe

- Works with Agilent's E84XX Series Mainframes
- Accommodates Signal, Power, Coaxial, Twinaxial, Pneumatic and Fiber Optics terminations
- Can accommodate VPC's Twin Access Contact for wireless board-to-board applications
- Fiber optic modules and contacts now available

Description

The VPC 2118/Gemini Interface incorporates various interconnect devices to provide direct PCB connection and discrete wired terminations in the same system. With 18 module positions, the Gemini Interface is designed for a 4-slot chassis but can be used on a 13-slot VXI chassis using a vertical hinged mounting frame.

The VPC 2118/Gemini Interface includes popular features from VPC's 90 Series product family, accommodating Signal, Power, Coaxial (50 Ω, 75 Ω, 18 GHz and 40 GHz), Twinaxial, Pneumatic and Fiber Optics terminations. And for wireless board-to-board applications, the Gemini Interface accommodates VPC's Twin Access Contact, allowing direct PCB connection.

This product is referenced by Agilent Technologies. It is manufactured and sold by Virginia Panel Corp. of Waynesboro, VA. Agilent does not sell, distribute, warrant, or support this product.

For more information contact:

Virginia Panel Corporation
Waynesboro, VA, U.S.A.
Telephone: 540-932-3300
www.vpc.com

Gemini

Ordering Information

Description	Product No.
Gemini Interface System	VPC 2118

Order from:

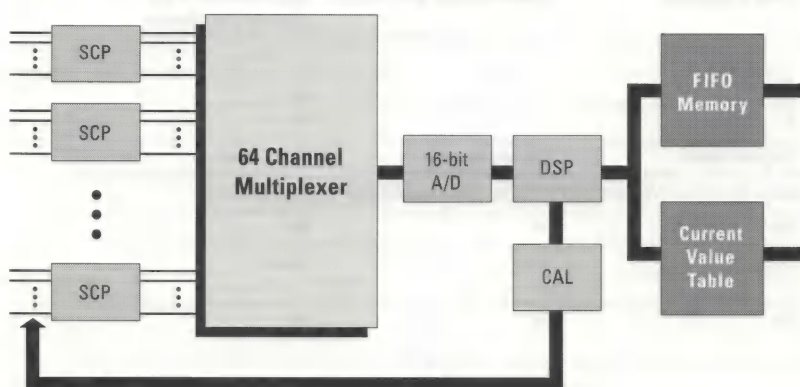
Virginia Panel Corporation
1400 New Hope Road
Waynesboro, VA 22980-2647
Telephone: 540-932-3300
www.vpc.com

Note: This product cannot be ordered from Agilent Technologies.

Referenced Product

The information for this product has been provided by Virginia Panel Corp. Agilent Technologies disclaims any and all liabilities for and makes no warranties, expressed or implied, with respect to this product, including without limitation the implied warranties of merchantability and fitness for a particular purpose. Providing information concerning this product does not constitute Agilent's endorsement of this product, Virginia Panel Corp., or its support services.

Agilent E1413C Block Diagram

**C-Size Scanning A/D Converters**

Product No.	Description
E1413C	High-Speed Scanning A/D Converter
E1415A	VXI Algorithmic Closed Loop Controller
E1419A	Multifunction ^{Plus} Measurement and Control
E1422A	Remote Channel Multifunction Data Acquisition & Control Module
E1501A - E1539A	Signal Conditioning Plug-ons (SCPs)

Remote Strain Conditioning

Product No.	Description
E1529A	Remote Strain Conditioning Unit (used with E1422A Remote Channel Multifunction Data Acquisition & Control Module and E1539A Remote Channel SCP)

Introduction

Scanning A/Ds and multifunction modules economically automate the acquisition of electronic and mechanical parameters. Normally, these voltage or resistance values are measured directly or from transducers sensing slowly changing parameters, (e.g., temperature, static pressure or strain). In its simplest form, a scanning A/D consists of a multiplexer, an A/D converter, and a system controller or computer. The system controller sequentially closes the multiplexer switches, records the corresponding voltmeter reading, and moves on to the next switch position. Data is not recorded simultaneously, but the scan rate is usually fast enough so data can be considered correlated for most purposes. Scanning A/Ds are optimized for accuracy at dc and low frequency. While today's scanning A/Ds are conceptually simple, they have evolved into sophisticated instruments, highly optimized for low-sample-rate data acquisition. They are fast, accurate, and provide both complete signal conditioning and high-level instrument functions.

A Signal Conditioning Plug-on (SCP) Guide is available in this product section. SCPs are listed by measurement type. You can obtain detailed SCP specifications in this section or on the Agilent Technologies Website (www.agilent.com/find/tmdir). Individual Data Sheets for these products are also available through your Agilent Sales Representative, or by contacting the nearest Agilent Sales Office or Service/Support Center.

Overview: Scanning A/D Converter Choices

Agilent Technologies provides a selection of scanning A/D converters with state-of-the-art technology in both functionality and performance. The E1419A Multifunction^{Plus} Module is ideal for mixed sensor and mixed signal data acquisition. Its intelligent measurement and control allows for scalable configurations, on-board engineering unit (EU) conversion, and real-time decision making. The E1413C High-Speed Scanning A/D contains a 64-channel multiplexer, an A/D converter, multiplexer control, a 64 kSample FIFO memory, on-board DSP, auto-calibration, and a current value table. Primary performance specifications are 16 bits of resolution at a scan rate of up to 56 kSamples/sec depending on configuration, with 0.01% of reading accuracy over as many as 64 active channels, and continuous data acquisition in many applications!

The E1415A VXI Algorithmic Closed Loop Controller is the perfect solution to tough monitoring and control applications. It bridges the gap between standard PID controllers and custom control systems. And, it is complete on a single module! All signal conditioning, process monitoring, control calculations, and control signals are handled on board without the need for computer supervision. Once setup is done, the module is essentially free-running.

The E1529A Remote Strain Conditioning Unit, used with the E1422A Remote Channel Multifunction Data Acquisition & Control Module, simplifies structural testing of designs that require many channels of strain measurement. Strain gage cables connect to the unit with standard RJ-45 telecom plugs, making it exceptionally easy to reconfigure or replace strain gages. The E1529A features built-in signal conditioning and a 32:1 multiplexing connection, which reduces overall system cost. Scan control, A/D conversion, and calibration are provided by the E1422A Remote Channel DAC module and the E1539A Remote Channel Signal Conditioning Plug-on. Other types of signals can also be measured by the E1422A using the other E1501A-E1538A SCPs that can be used with the other Scanning A/Ds.

Family Specifications

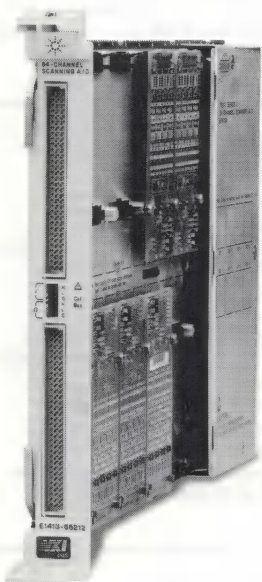
Model	E1413C	E1415A	E1419A	E1422A
Description	High-Speed Scanning A/D Converter	VXI Algorithmic Closed Loop Controller	Multifunction ^{Plus} Measurement and Control	Remote Channel Multifunction Data Acquisition Module
VXI Characteristics				
Size:	C	C	C	C
Slots:	1	1	1	1
VXI device type:	Register based	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.				
VXIplug&play Win Framework:	No	No	No	No
VXIplug&play Win 95/98/NT Framework:	Yes	Yes	Yes	Yes
VXIplug&play HP-UX Framework:	No	No	No	No
Specifications				
Measurement resolution (including sign):	16 bit	16 bit	16 bit	16 bit
Memory:	64 kSa	64 kSa	64 kSa	FIFO: 64 kSa Program: 40kByte
Number of channels:	64 max.	64 max.	64 max.	64 max via E1501A-38A SCPs; 512 max via E1529A/E1539A
Maximum reading rate:	100 kSamples/s divided by the number of channels in the scan	Up to 56 kSamples/s dependent upon configuration	Up to 56 kSamples/s dependent upon configuration	25 kSamples/s
Measurement accuracy:	Typically $\pm 0.01\%$ of input level; varies with the SCP used and calibration.	Typically $\pm 0.01\%$ of input level; varies with the SCP used and calibration.	Typically $\pm 0.01\%$ of input level; varies with the SCP used and calibration.	Typically $\pm 0.015\%$ of input level; varies with the SCP used and calibration
Signal Conditioning Plug-ons (SCPs) supported:				
	E1501A, E1502A, E1503A, E1505A, E1506A, E1507A, E1508A, E1509A, E1510A, E1511A, E1512A, E1513A, E1518A	E1501A, E1502A, E1503A, E1505A, E1506A, E1507A, E1508A, E1509A, E1510A, E1511A, E1512A, E1513A, E1518A, E1531A, E1532A, E1533A, E1536A, E1538A	E1501A, E1502A, E1503A, E1505A, E1506A, E1507A, E1508A, E1509A, E1510A, E1511A, E1512A, E1513A, E1518A, E1531A, E1532A, E1533A, E1536A, E1538A	E1501A, E1502A, E1503A, E1505A, E1506A, E1507A, E1508A, E1509A, E1510A, E1511A, E1512A, E1513A, E1518A, E1531A, E1532A, E1533A, E1536A, E1538A, E1539A

Please refer to the SCP Selection Guide for application measurement information.

NOTE: DMM and multiplexer cards can also be combined to make high-accuracy/low-speed or medium-accuracy/moderate-speed scanning A/Ds. See the Agilent E1411B + E1476A/E1460A/E8460A, and the Agilent E1326B + E1345A/51A/53A.

64-Channel Scanning A/D Converter, C-Size

Agilent E1413C



Agilent E1413C

- Comprehensive signal conditioning on board
- Flexible scanning/auto sequencing
- High-speed data transfers into controller
- On-board data reduction and hi/low limit checking
- Signal digitizing to 100 kHz sampling rate (*)

Description

The Agilent Technologies E1413C 64-Channel Scanning A/D is a C-size, 1-slot, register-based VXI module. It is designed for high-performance data acquisition and computer-aided test applications. The key requirements of these applications are high-speed scanning, 16-bit resolution, high accuracy (0.01% of reading), 4 mV to 16 V full-scale input (60 V with Agilent E1513A attenuator SCP), 64 kSa dual-ported FIFO buffer for fast data transfers, current value buffer for on-line monitoring, and automatic self-calibration.

The available ranges are determined by the SCP used. An SCP is required for every input. Each SCP normally supplies input signal conditioning for eight (8) channels. See the individual SCP Data Sheet for more information.

The unique design of the analog subsystem provides a new level of density by combining a 16-bit A/D with a 64-channel differential FET multiplexer. Up to eight Signal Conditioning Plug-ons (SCP's)—most with eight channels each—can be added to the E1413C to provide additional capabilities (i.e., direct input, 10 Hz low-pass filtering, fixed gain/filter per channel, etc.).

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

(* 100 kSa/s maximum sampling/scanning rate divided by the number of channels in the scan list, which can be 1 to 64.)

Multifunction Measurement Capability

This module provides multifunction measurement capability within individual scans without any configuration re-programming. These include dc voltage, temperature, resistance, and strain.

Comprehensive Signal Conditioning On Board

A full range of signal conditioning is provided by optional Signal Conditioning Plug-on daughter boards (SCPs) that mount inside the E1413C. Most SCPs buffer the signal to be measured and filter or amplify it before presenting it to the E1413C's FET multiplexer and A/D converter. Other available SCPs provide more advanced functions such as sample-and-hold, and strain bridge excitation and completion. The SCPs supported by the E1413C are:

- E1501A 8-Channel Direct Input SCP
- E1502A 8-Channel 7 Hz Low-pass Filter SCP
- E1503A 8-Channel Programmable Filter and Gain SCP
- E1505A 8-Channel Current Source SCP
- E1506A 8-Channel 120 Ω Strain Completion & Excitation SCP
- E1507A 8-Channel 350 Ω Strain Completion & Excitation SCP
- E1508A 8-Channel x16 Gain & 7 Hz Fixed Filter SCP
- E1509A 8-Channel x64 Gain & 7 Hz Fixed Filter SCP
- E1510A 4-Channel Sample & Hold Input SCP
- E1511A 4-Channel Transient Strain SCP
- E1512A 8-Channel 25 Hz Fixed Filter SCP
- E1513A 8-Channel Divide-by-16 Fixed Attenuator & 7 Hz Low-pass Filter SCP
- E1518A 4-Wire Resistance Measurement SCP

Refer to the information on each individual SCP for more details.

Flexible Scanning/Auto Sequencing

Measurement scans can be made in any channel order using any function on any channel—all at full speed, including autoranging. Up to four unique scan lists, each with up to 1,024 channel entries, can be stored in RAM and selected on the fly with a single software command. In addition, these scan lists can be automatically sequenced with a unique auto sequencing scan list. Lists can be sequenced so as to simplify the scanning of channels at different rates.

High-Speed Data Transfers into Controller

Data transfer speed has been greatly improved because multiple E1413Cs can scan in parallel at full speed and then sequentially transfer data over the VXI backplane in D16 or D32 format at rates that match even the fastest embedded VXI computer. And the data is transferred in computer-ready, IEEE-754, 32-bit floating-point real Engineering Unit format. Two on-board RAMs facilitate overall performance. The FIFO RAM is a dual-ported high-speed buffer that stores up to 64,000 samples until the controller is ready for efficient fast data transfer. For on-line monitoring, the Current Value Table RAM contains the most recently measured values for each channel in use. The CVT and FIFO RAMs can be accessed asynchronously.

On-Board Data Reduction and Hi/Low Limit Checking

Averaging can be enabled on a scan basis to provide averaging for each channel over two to 256 samples in binary steps. The averaged data goes to both the CVT and the FIFO buffer. The maximum sample rate is >1.5 kSa/s per channel for 64 channels, although higher rates are possible with fewer channels. When averaging multiple channels in a scan list, scan list switching and autoranging are not allowed. This would distort the average.

Individual high and low limits per channel can be downloaded to the E1413C in engineering units format. If a limit is exceeded, an interrupt or trigger line can be pulled and the limit register can be read to determine the out-of-limit channel. A cumulative mode can be selected that holds the channel number of any out-of-limit reading since the last INIT command. The FIFO buffer can then be read to determine the actual out-of-limit readings.

Signal Digitizing

The E1413C is suitable for digitizing of multichannel transient signals up to a 1 kHz sampling rate when used with the E1510A 4-Channel Sample & Hold Input SCP anti-aliasing filters. Digitizing higher frequency signals using the E1501A 8-Channel Direct Input SCP will require the use of external anti-aliasing filters. The scan trigger, either internally or externally generated, is used to initiate the channel samples controlled by the internal sample timer. The typical scan trigger jitter time is ± 100 ps.

Signal Conditioning Plug-Ons

A Signal Conditioning Plug-on (SCP) is a small daughter board that mounts on Agilent's VXI scanning measurement and control modules. These SCPs provide a number of input and output functions. Several include gain and filtered analog inputs for measuring electrical and sensor-based signals.

Refer to the information on each individual SCP for more details.

(Agilent E1413C continued)

Voltage Measurements

Use any of the following SCPs with the E1413C to make voltage measurements: E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, or E1513A.

Temperature Measurements

Any of the input SCPs can be used to make temperature measurements with thermocouples, thermistors, or RTDs, but the E1503A/E1508A/E1509A SCPs provide higher accuracy with thermocouples.

Resistance Measurements

Resistance is measured using the E1505A 8-Channel Current Source SCP and an input SCP or the E1518A 4-Wire Resistance Measurement SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown. The current source is provided through the E1505A.

Static Strain Measurements

The E1506A and E1507A SCPs provide a convenient way to measure a few channels of static strain. When using the E1506A/E1507A for bridge completion, a second SCP is required to make the measurement connection. You can use the following SCPs for this type of static strain measurements:

- E1503A 8-Channel Programmable Filter/Gain SCP
- E1506A 8-Channel 120 Ω Strain Completion & Excitation SCP
- E1507A 8-Channel 350 Ω Strain Completion & Excitation SCP
- E1508A 8-Channel 7 Hz Fixed Filter & x16 Gain SCP
- E1509A 8-Channel 7 Hz Fixed Filter & x64 Gain SCP

For applications requiring more than eight channels of strain measurement, the combination of the Agilent E1422A/E1529A/E1539A provides a more cost effective approach to static (and dynamic) strain measurements.

Transient Measurements

When making higher speed measurements, a vital issue often is the time skew between channels. Ideally, in many applications, the sampled data is needed at essentially the same instant in time. The intrinsic design of the E1413C provides scanning of 64 channels with maximum skew of 640 μ s between the first and last channels, far less than most sampled data systems.

Transient Voltage Measurements

The E1510A provides basic sample-and-hold capabilities on four channels. Six-pole Bessel filters provide alias and alias-based noise reduction while giving excellent transient response without overshoot or ringing. The E1510A can be used in strain applications primarily where the bridge is external.

Transient Strain Measurements

The E1511A, a double-wide SCP, has all the capabilities of the E1510A but adds on-board bridge excitation and completion functions. The four direct input channels are used for monitoring the bridge excitation. A maximum of four SCPs (16 channels) can be installed on an E1413C.

Automated Calibration for Better Measurements

The E1413C offers superior calibration capabilities that provide more accurate measurements. Periodic calibration of the scanning A/D is accomplished by connecting an external voltage measurement standard (such as a highly accurate multimeter) to the inputs of the scanning A/D. This external standard first calibrates the on-board calibration source. Then built-in calibration routines use the on-board calibration source and on-board switching to calibrate the entire signal path from the scanning A/D's input, through the signal conditioning plug-ons (SCPs) and FET MUX, to the A/D itself. Subsequent daily or short-term calibrations of this same signal path can be quickly and automatically done using the internal calibration source to eliminate errors introduced by the signal path through the SCPs and FET MUX, or by ambient temperature changes. All 64 channels can be quickly and productively calibrated to assure continued high-accuracy measurements.

In addition to the calibration of the signal path within the scanning A/D, the E1413C allows you to perform a "Tare Cal" to reduce the effects of voltage offsets and IR voltage drops in your signal wiring that is external to the scanning A/D. The Tare Cal uses an on-board D/A to eliminate these voltage offsets. By placing a short circuit across the signal or transducer being measured, the residual offset can be automatically measured and eliminated by the D/A. Tare Cal should not be used to eliminate the thermoelectric voltage of thermocouple wire on thermocouple channels.

Configuration

Twelve E1413C modules may be used in a 13-slot, C-size mainframe for a total of 768 channels. A C-size configuration using MXIbus allows you to link together multiple mainframes on a single backplane for larger scanning A/D systems. The Agilent E1406A may require additional RAM to use this module.

Note: For field wiring, the use of shielded twisted pair wiring is highly recommended.

Timing Signals

Timing:	Scan-to-scan timing and sample-to-sample timing can be set independently.
Scan triggers:	Can be derived from a software command or a TTL level from other VXI modules, internal timer, or external hardware. Typical latency 17.5 μ s.
Synchronization:	Multiple E1413C modules can be synchronized at the same rate using the TTL trigger output from one E1413C to trigger the others.
Alternate synchronization:	Multiple E1413C modules can be synchronized at different integer-related rates using the scan timer/N mode and the TTL trigger output from one E1413C module to trigger the others.

Scan Triggers

Internal:	100 μ sec to 6.5536 sec
Resolution:	100 μ sec
Trigger count:	1 to 65535 or infinite

Sample Timer

Range:	10 μ sec to 32768 msec
Resolution:	0.5 μ sec

Measurement Specifications

The following specifications include the SCP and scanning A/D performance together as a unit. Accuracy is stated for a single sample. Averaging multiple samples will improve accuracy by reducing noise of the signal. The basic E1413C scanning A/D has a full scale range of ± 16 V and five autoranging gains of x1, x4, x16, x64, and x256. An SCP must be used with each eight channel input block to provide input protection and signal conditioning. Refer to the information on each individual SCP for measurement specifications.

Product Specifications

Measurement resolution:	16 bits (including sign)
Maximum reading rate:	100 kSamples/s divided by the number of channels in the scan. For example: 100k/64 = 1.56k samples/sec/ch 100k/16 = 6.25k samples/sec/ch
Memory:	64 kSa
Maximum input voltage:	Normal mode plus common mode
Operating:	$\leq \pm 16$ V peak
Damage level:	$\geq \pm 42$ V peak
Maximum common mode voltage:	
Operating:	$\leq \pm 16$ V peak
Damage level:	$\geq \pm 42$ V peak
SCP input impedance:	>100 M Ω differential
Maximum tare cal offset:	62.5 mV range $\pm 75\%$ of full scale other ranges $\pm 25\%$ of full scale
Jitter:	
Phase jitter scan-to-scan:	80 ps rms
Phase jitter card-to-card:	41 ns peak 12 ns rms

(Agilent E1413C continued)

Measurement Accuracy

Specifications are 90 days, $23 \pm 1^\circ\text{C}$, with *CAL done after a 1 hr warm-up and CAL:ZERO done within 5 minutes.

Note: Beyond the 5 min. limitation and CAL:ZERO not done, apply the following drift error: Drift = $10 \mu\text{V}/^\circ\text{C} \div \text{SCP gain}$, per $^\circ\text{C}$ change from CAL:ZERO temperature.

Accuracy Data

Measurement accuracy is dependent upon the SCP module used. Refer to the accuracy tables and graphs for the individual SCP to determine the overall measurement accuracy.

Many definitions of accuracy are possible. Here we use single-shot with 3 sigma noise. To calculate accuracy assuming temperature is held constant within $\pm 1^\circ\text{C}$ of the temperature at calibration, the following formula applies:

$$\text{Single Shot } 3\sigma = \pm(\sqrt{(\text{GainError})^2 + (\text{OffsetError})^2} + 3\sigma \text{ noise})$$

Correcting for Temperature

To calculate accuracy over temperature range outside the $\pm 1^\circ\text{C}$ range, results after *CAL are given by replacing each of the above error terms as follows:

Replace

$$(\text{GainError})^2$$

with

$$(\text{GainError})^2 + (\text{GainTempco})^2$$

Replace

$$(\text{OffsetError})^2$$

with

$$(\text{OffsetError})^2 + (\text{OffsetTempco})^2$$

Power Available for SCPs

$\pm 24 \text{ V}$:	1 A
5 V:	3.5 A

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A16/A24
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	TTL Trigger bus (T)

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/98/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

*The Agilent VEE application can use VXIplug&play drivers or panel drivers.

Cooling/Slot

Watts/slot:	15.00
ΔP mm H ₂ O:	0.08
Air flow liter/s:	0.08

Module Current (with no SCPs installed)

	I_{PM} (A)	I_{DM} (A)
+5 V:	1.0	0.02
+12 V:	0.06	0.01
-12 V:	—	—
+24 V:	0.1	0.01
-24 V:	0.1	0.01
-5.2 V:	0.15	0.01
-2 V:	—	—

Ordering Information

Description	Product No.
Scanning A/D Converter	E1413C
Service manual	E1413C 0B3
Interface to rack mount terminal panel	E1413C A3F
3 yr. rtn. to Agilent to 1 yr. OnSite warr.	E1413C W01
Extra Terminal Block	E1413-80011
Term Blk A3F HI 50-pin Conn	E1413-80013
8-Channel Direct Input SCP	E1501A
8-Channel 7 Hz Low-pass Filter SCP	E1502A
8-Channel Programmable Filter/Gain SCP	E1503A
8-Channel Current Source SCP	E1505A
8-Channel 120 Ω Strain Completion & Excitation SCP	E1506A
8-Channel 350 Ω Strain Completion & Excitation SCP	E1507A
8-Channel x16 Gain & 7 Hz Fixed Filter SCP	E1508A
8-Channel x64 Gain & 7 Hz Fixed Filter SCP	E1509A
4-Channel Sample & Hold Input SCP	E1510A
4-Channel Transient Strain SCP	E1511A
8-Channel 25 Hz Fixed Filter SCP	E1512A
8-Channel $\div 16$ Fixed Attenuator & 7 Hz Low-pass Filter SCP	E1513A
4-Wire Resistance Measurement SCP	E1518A

For More Information

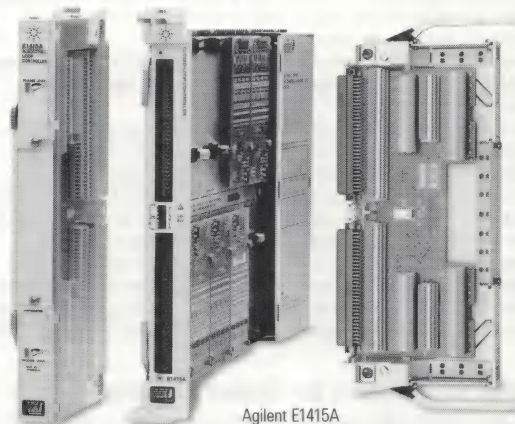
For more detailed information on individual SCPs, refer to the corresponding catalog pages for those products, or contact Agilent to request individual data sheets.

Publication No.: 5965-5583E

Algorithmic Closed Loop Controller and Remote Channel Multifunction Data Acquisition & Control Module

17

Agilent E1415A, E1422A



Agilent E1415A

- Powerful data acquisition capability
- Powerful control capability
- Comprehensive on-board signal conditioning
- Custom on-board DSP program development
- Wide choice of input/output signal types
- Large channel-count strain signal conditioning and measurement

(Agilent E1415A, E1422A continued)**Description**

The Agilent Technologies E1415A and E1422A are C-size, 1-slot, VXI modules capable of either multi-function input/output (data acquisition) or powerful control capabilities. They serve as powerful data acquisition modules that handle analog input/output and digital input/output in both static and dynamic modes. The digital capability includes the ability to set or sense static states, to measure input frequency and period, to totalize, and to input or output PWM and FM signals.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Algorithmic Closed Loop Controller**Agilent E1415A**

More powerful than PID controllers and easier to implement than large custom control systems, the E1415A fills a unique niche in the data acquisition and control field, providing both control and precise data acquisition. Applications include:

- PID control of stimulus loops such as hydraulic actuators, levers, rotational devices as in structural test
- PID control of temperature, position, velocity, acceleration etc.
- Complex control such as cascade loops in thermal cooling jackets, ratio
- Independent loops with multi-level alarms.

The design of the on-board, DSP firmware assures the user that all inputs, all calculations, and all outputs can be completed between scan triggers. This means there is no drift, or jitter in the critical time intervals that are used to calculate integrals and derivatives in control algorithms.

The firmware allows a user to employ pre-written Agilent PID control algorithms, modify them for specific application needs, or to write an application from scratch. Low duty-cycle connection to the host computer allows interaction between the host and real-time DSP so the user can update algorithms, change tuning constants, or do envelope control. Limited host computer interaction leads to very high performance (8-loops, update rate 1000/second per loop with simple PID calculation included).

Remote Channel Multi-Function Data Acquisition & Control Module
Agilent E1422A

The E1422A is a module that is essentially the same as the E1415A and has all of the same data acquisition and control capabilities as the E1415A, and then some. The few minor differences are described here.

The E1422A Remote Channel Multi-Function DAC Module supports the E1539A Remote Channel Signal Conditioning Plug-on, and the E1529A Remote Strain Signal Conditioning Unit to form a high-performance but economical Strain Measurement System. The E1422A serves as the controller in this system, managing all the configuration, calibration, triggering of measurements, EU conversion and calibration processes.

The principal differences between the E1415A and E1422A are these:

- The E1422A has 40 Kbytes of memory available for user algorithms; the E1415A has 48 Kbytes.
- If the only thing being done in an application is collection of strain data, the E1422A user doesn't have to write an algorithm, as for the E1415A.
- The E1422A offers the same two Terminal Blocks (Option 011 screw terminals and Option 013 spring clamp) as does the E1415A. Additionally, the E1422A offers a third Terminal Block (Option 001 16 RJ-45 connectors). Option 001 is very powerful for a system dedicated solely to strain measurements, but doesn't have an isothermal strip (as Options 011 and 013 do), and should not be used with thermocouples. Options 011 and 013 can be used for general-purpose data acquisition, including thermocouples. For strain, the 4-pair cable connections are wired directly into the terminal block.

Automated Calibration for Better Measurements

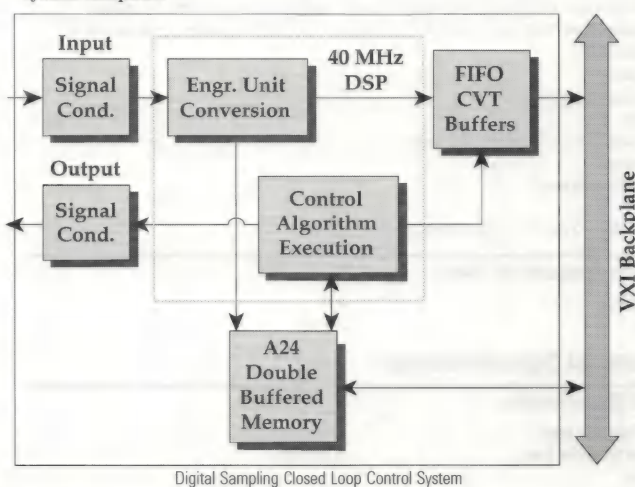
The E1415A and E1422A offer superior calibration capabilities that provide more accurate measurements. Periodic calibration of the module's measurement inputs is accomplished by connecting an external voltage measurement standard (such as a highly accurate multimeter) to the inputs of the module. This external standard first calibrates the on-board calibration source. Then built-in calibration routines use the on-board calibration source and on-board switching to calibrate the entire signal path from the closed loop controller's input, through the signal conditioning plug-ons (SCPs) and FET MUX, to the A/D itself. Subsequent daily or short-term calibrations of this same signal path can be quickly and automatically done using the internal calibration source to eliminate errors introduced by the signal path through the SCPs and FET MUX or by ambient temperature changes. All input channels can be quickly and productively calibrated to assure continued high-accuracy measurements.

In addition to the calibration of the signal paths within the modules, the E1415A and E1422A allow you to perform a "Tare Cal" to reduce the effects of voltage offsets and IR voltage drops in your signal wiring that is external to the module. The Tare Cal uses an on-board D/A to eliminate these voltage offsets. By placing a short circuit across the signal or transducer being measured, the residual offset can be automatically measured and eliminated by the D/A. Tare Cal should not be used to eliminate the thermoelectric voltage of thermocouple wire on thermocouple channels.

Flexibility with Deterministic Control

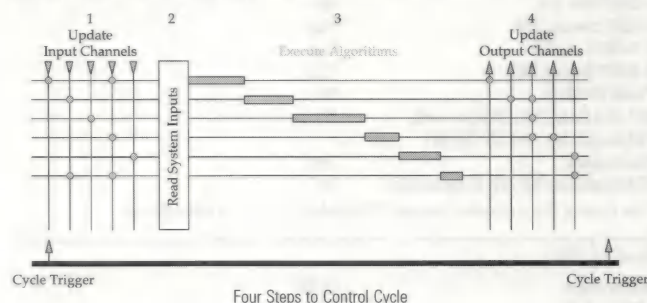
The E1415A and E1422A are digital sampling closed loop control systems that are complete in a single VXI module. All signal conditioning, process monitoring, control calculations, and control signals are handled on-board without the need for computer supervision. Once setup is done, the module is essentially free-running.

The inputs are updated at the beginning of each cycle and the outputs are updated at a later deterministic time in the cycle so that various paths in the control algorithm do not affect the loop timing. These steps are executed automatically and deterministically without need for intervention from a system computer.



The E1415A/E1422A combine flexibility with deterministic control. Control algorithms for each of the loops can be the default PID calculation or a user-defined, downloaded, custom algorithm. The loop update rate is deterministically controlled by an internal clock so that variations in the algorithm execution times do not affect the loop cycle time.

There are four steps to each control cycle: 1) Input channels are measured, 2) System inputs are updated, 3) Control algorithms are executed, and 4) Output signals are updated.

**Powerful Control Capability**

The control algorithm for each loop is easily developed by the user from a list of algebraic expressions and flow constructs such as IF, THEN, ELSE. Tuning is simplified because all of the constants in the algorithm as well as the algorithm itself can be updated on-the-fly. New values are double-buffered so there is no need to stop scanning the inputs or halt the algorithm execution.

The on-board 40 MHz pipelined DSP provides highly deterministic execution, making it easy to accurately predict cycle times. Engineering unit conversions for temperature, strain, resistance, and voltage measurements are made automatically without slowing down the algorithm execution speed.

(Agilent E1415A, E1422A continued)**Wide Choice of Inputs/Outputs**

The inputs to the loop algorithm can be measured values from multiple channels, operator input values, outputs from other loops, or values from other subsystems. The E1415A/E1422A have a variety of signal conditioning plug-ons for making measurements of:

- Temperature, strain
- Voltage, current, resistance
- RPM, frequency, totalize
- Discrete levels, TTL, contact closures

In addition, the measured input values and the calculated output values can be stored in a 64,000-sample FIFO buffer and efficiently transferred to the controlling computer in blocks of data. With this feature, it is no longer necessary to waste resources by dedicating a data acquisition channel to monitor each control loop input and output. The result of any algorithm calculation can be an input for use by another loop or subsystem, or it can be a direct output of several different types. Among the choices of output are:

- Analog voltage
- Analog current
- Discrete levels (TTL)
- Pulse width modulation (TTL)

As an example of output flexibility, the pulse width modulation output has several modes. In the PWM free-run mode, the frequency or pulse width output rate is independent of the loop update rate and can be changed once per loop update cycle. The square wave mode provides a variable frequency, fixed 50% duty cycle output signal. The pulse-per-update mode provides a variable width pulse synchronized to the loop update cycle.

Operator Control

Manual control can be implemented through a user software interface or external hardware, such as a potentiometer. Bumpless transfer from auto to manual mode, or manual to auto is handled automatically by a set-point-tracking routine in the default PID algorithm code.

Signal Conditioning Plug-Ons

A Signal Conditioning Plug-on (SCP) is a small daughter board that mounts on Agilent's VXI scanning measurement and control modules. These SCPs provide a number of input and output functions. Several include gain and filtered analog inputs for measuring electrical and sensor-based signals, as well as frequency, total event count, pulse-width modulation, toothed-wheel velocity, and digital state. Output functions include analog voltage and current D/As, 8- or 16-bit digital outputs, pulse output with variable frequency and PWM, and stepper motor control.

Refer to the information on each individual SCP for more details.

Voltage Measurements

Use any of the following SCPs with the E1415A/E1422A to make voltage measurements: E1501A, E1502A, E1503A, E1508A, E1509A, E1512A or E1513A.

Temperature Measurements

Any of the input SCPs can be used to make temperature measurements with thermocouples, thermistors, or RTDs, but the E1503A/E1508A/E1509A SCPs provide higher accuracy with thermocouples.

Resistance Measurements

Resistance is measured using either the E1505A 8-Channel Current Source SCP and an input SCP or the E1518A 4-Wire Resistance Measurement SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown.

Static Strain Measurements

There are two ways to make static strain measurements. The E1506A and E1507A SCPs provide a convenient way to measure a few channels of static strain. When using the E1506A/E1507A for bridge completion, a second SCP is required to make the measurement connection. You can use the following SCPs for this type of static strain measurements:

- E1503A 8-Channel Programmable Filter/Gain SCP
- E1506A 8-Channel 120 Ω Strain Completion & Excitation SCP
- E1507A 8-Channel 350 Ω Strain Completion & Excitation SCP
- E1508A 8-Channel 7 Hz Fixed Filter & x16 Gain SCP
- E1509A 8-Channel 7 Hz Fixed Filter & x64 Gain SCP

The combination of the E1422A/E1529A/E1539A provide a more cost-effective approach to static (and dynamic) strain measurements, especially for applications requiring more than eight channels. Dynamic strain measurements are implemented by connecting the E1529A to high-speed digitizers, such as the Agilent E1432A and E1433B.

Note: SCPs are also available for making dynamic strain measurements (Agilent E1510A and E1511A).

Transient Measurements

When making higher speed measurements, a vital issue often is the time skew between channels. Ideally, in many applications, the sampled data is needed at essentially the same instant in time. While the intrinsic design of the E1415A/E1422A provides scanning of 64 channels, with maximum skew of 640 μ S between the first and last channel (far less than most sampled data systems), this still may not be small enough skew for some applications.

Transient Voltage Measurements

The E1510A provides basic sample-and-hold capabilities on four channels. Six-pole Bessel filters provide alias and alias-based noise reduction while giving excellent transient response without overshoot or ringing. The E1510A can be used in strain applications primarily where the bridge is external.

Transient Strain Measurements

The E1511A, a double-wide SCP, has all the capabilities of the E1510A but adds on-board bridge excitation and completion functions. The four direct input channels are used for monitoring the bridge excitation. A maximum of four SCPs (16 channels) can be installed on an E1415A/E1422A.

Analog Output

Use the E1531A for voltage outputs, and the E1532A for current outputs. The E1531A and E1532A have eight (8) output channels available on each SCP.

A maximum of seven (7) E1532A SCPs can be installed on each E1415A/E1422A due to power limitations. There are no power restrictions on the E1531A.

Digital I/O

Use the E1533A Digital I/O SCP to provide two 8-bit input/output words.

Frequency/Totalize/PWM

The E1538A Enhanced Frequency/Totalize/PWM SCP provides eight (8) channels which can be individually configured as a frequency or totalizer input, or as a pulse width modulated output.

(Agilent E1415A, E1422A continued)

Compact Packaging with Signal Conditioning

The E1415A/E1422A provide for configurable signal conditioned I/O with up to eight individual plug-ons for analog, digital, and frequency needs. The capabilities of the SCPs for the E1415A/E1422A are:

- E1501A 8-Channel Direct Input SCP
- E1502A 8-Channel 7 Hz Low-pass Filter SCP
- E1503A 8-Channel Programmable Filter and Gain SCP
- E1505A 8-Channel Current Source SCP
- E1506A 8-Channel 120 Ω Strain Completion & Excitation SCP
- E1507A 8-Channel 350 Ω Strain Completion & Excitation SCP
- E1508A 8-Channel x16 Gain & 7 Hz Fixed Filter SCP
- E1509A 8-Channel x64 Gain & 7 Hz Fixed Filter SCP
- E1510A 4-Channel Sample & Hold Input SCP
- E1511A 4-Channel Transient Strain SCP
- E1512A 8-Channel 25 Hz Fixed Filter SCP
- E1513A 8-Channel Divide-by-16 Fixed Attenuator & 7 Hz Low-pass Filter SCP
- E1518A 4-Wire Resistance Measurement SCP
- E1531A 8-Channel Voltage Output SCP
- E1532A 8-Channel Current Output SCP
- E1533A 16-Bit Digital I/O SCP
- E1536A 8-Bit Isolated Digital I/O SCP
- E1538A Enhanced Frequency/Totalize/PWM SCP
- E1539A Remote Channel SCP (E1422A only)

Product Specifications

Note: For specifications of the E1422A used with the E1529A/E1539A as a remote strain measurement system, see the E1529A/E1539A section. For other functions of the E1422A, refer to the following E1415A/E1422A specifications.

Timing Signals

Timing:	Scan-to-scan timing and sample-to-sample timing can be set independently.
Scan triggers:	Can be derived from a software command or a TTL level from other VXI modules, internal timer, or external hardware. Typical latency 17.5 μ s.
Synchronization:	Multiple E1415A/E1422A modules can be synchronized at the same rate using the TTL trigger output from one E1415A/E1422A to trigger the others.
Alternate synchronization:	Multiple E1415A/E1422A modules can be synchronized at different integer-related rates using the ALG:SCAN:RATIO command and the TTL trigger output from one E1415A/E1422A module to trigger the others.

Scan Triggers

Internal:	100 μ sec to 6.5536 sec
Resolution:	100 μ sec
Trigger count:	1 to 65535 or infinite

Sample Timer

Range:	E1415A: 10 μ sec to 32768 msec E1422A: 40 μ sec to 32768 msec
Resolution:	0.5 μ sec

Measurement Specifications

The following specifications include the SCP and scanning A/D performance together as a unit. Accuracy is stated for a single sample. Averaging multiple samples will improve accuracy by reducing noise of the signal. The basic E1415A/E1422A scanning A/D has a full scale range of ± 16 V and five autoranging gains of x1, x4, x16, x64, and x256. An SCP must be used with each eight-channel input block to provide input protection and signal conditioning. Refer to the information on each individual SCP for measurement specifications.

Note: For field wiring, the use of shielded twisted pair wiring is highly recommended.

Measurement resolution:	16 bits (including sign)
Maximum reading rate:	E1415A: Up to 56 kSamples/s dependent upon configuration E1422A: Up to 25 kSamples/s dependent upon configuration
Memory:	64 kSa
Maximum input voltage:	Normal mode plus common mode
Operating:	$< \pm 16$ V peak
Damage level:	$> \pm 42$ V peak
Maximum common mode voltage:	
Operating:	$< \pm 16$ V peak
Damage level:	$> \pm 42$ V peak
SCP input impedance:	> 100 M Ω differential
Maximum tare cal offset:	62.5 mV range $\pm 75\%$ of full scale
Jitter:	
Phase jitter scan-to-scan:	80 ps rms
Phase jitter card-to-card:	41 ns peak 12 ns rms

Measurement Accuracy

Typically $\pm 0.01\%$ of input level; varies with the SCP used. Specifications are 90 days, 23 ± 1 $^{\circ}$ C, with *CAL done after a 1 hr warm-up and CAL:ZERO done within 5 minutes.

Note: Beyond the 5 min. limitation and CAL:ZERO not done, apply the following drift error: Drift = 10μ V/ $^{\circ}$ C \div SCP gain, per $^{\circ}$ C change from CAL:ZERO temperature.

Accuracy Data

Measurement accuracy is dependent upon the SCP module used. Refer to the accuracy tables and graphs for the individual SCP to determine the overall measurement accuracy.

Many definitions of accuracy are possible. Here we use single-shot with 3 sigma noise. To calculate accuracy assuming temperature is held constant within ± 1 $^{\circ}$ C of the temperature at calibration, the following formula applies:

Single Shot $3\sigma =$

$$\pm(\sqrt{(\text{GainError})^2 + (\text{OffsetError})^2} + 3\sigma \text{ noise})$$

Correcting for Temperature

To calculate accuracy over temperature range outside the ± 1 $^{\circ}$ C range, results after *CAL are given by replacing each of the above error terms as follows:

Replace
(GainError)²
with
(GainError)² + (GainTempco)²
Replace
(OffsetError)²
with
(OffsetError)² + (OffsetTempco)²

(Agilent E1415A, E1422A continued)

Loop Control Specifications

Number of loops:	1 to 32
Default control algorithm type:	PID
Maximum E1415A loop update rate for default PID algorithm:	
(Note: E1422A maximum sample rate is 25 kSamples/s, compared to 56 kSamples/s for the E1415A. The loop speeds of the E1422A are reduced in same ratio.)	
1 loop:	3 kHz
8 loops:	1 kHz
32 loops:	250 Hz
Custom algorithm development:	
Language:	Subset of C, programming language including if-then-else, most math and comparison operations.
Variable types:	Scalar local and global variables, array local and global variables.
Intrinsic functions:	interrupt(), writefifo(), writecv(), writeboth(), min(), max(), abs().
Other functions:	Create own custom functions to handle transcendental operations.

I/O General

A total of eight (8) Signal Conditioning Plug-ons (SCPs) can be installed in most combinations of input or output configurations on a single E1415A/E1422A.

Power Available for SCPs

±24 V:	1.0 A
5 V:	3.5 A

General Specifications**VXI Characteristics**

VXI device type:	A16, slave only, register based
Data transfer bus:	n/a
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	TTL Trigger bus (T)

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/98/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

*The Agilent VEE Application can use VXIplug&play drivers or panel drivers.

Cooling/Slot

Watts/slot:	14.00
ΔP mm H₂O:	0.08
Air flow liter/s:	0.8

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	1.0	0.02
+12 V:	0.06	0.01
-12 V:	—	—
+24 V:	0.01	0.01
-24 V:	0.1	0.01
-5.2 V:	0.15	0.01
-2 V:	—	—

Ordering Information

Description	Product No.
Algorithmic Closed Loop Controller	E1415A
Interface to rack mount terminal panel	E1415A A3F
3 yr. rtn. to Agilent to 1 yr. OnSite warr.	E1415A W01
Remote Channel Multi-function Data Acquisition & Control Module	E1422A
16-Port RJ-45 Connector Block	E1422A 001
Screw Terminal Connector Block	E1422A 011
Spring Clamp Terminal Connector	E1422A 013
8-Channel Direct Input SCP	E1501A
8-Channel 7 Hz Low-pass Filter SCP	E1502A
8-Channel Programmable Filter/Gain SCP	E1503A
8-Channel Current Source SCP	E1505A
8-Channel 120 Ω Strain Completion & Excitation SCP	E1506A
8-Channel 350 Ω Strain Completion & Excitation SCP	E1507A
8-Channel x16 Gain & 7 Hz Fixed Filter SCP	E1508A
8-Channel x64 Gain & 7 Hz Fixed Filter SCP	E1509A
4-Channel Sample & Hold Input SCP	E1510A
4-Channel Transient Strain SCP	E1511A
8-Channel 25 Hz Fixed Filter SCP	E1512A
8-Channel ÷ 16 Fixed Attenuator & 7 Hz Low-pass Filter SCP	E1513A
4-Wire Resistance Measurement SCP	E1518A
8-Channel Voltage Output SCP	E1531A
8-Channel Current Output SCP	E1532A
16-Bit Digital I/O SCP	E1533A
8-Bit Isolated Digital I/O SCP	E1536A
Enhanced Frequency/Totalize/PWM SCP	E1538A
Remote Channel Signal Conditioning Plug-on	E1539A

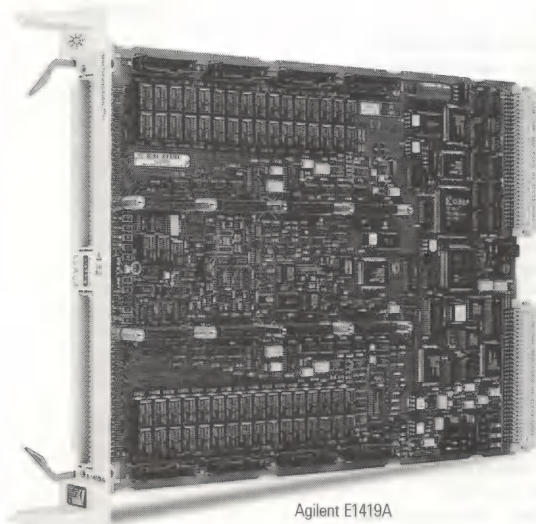
For More Information

For more information on individual SCPs, refer to the corresponding catalog pages for those products, or contact Agilent to request individual data sheets. For more information on the E1422A/E1529A/E1539A Strain Measurement System, refer to *Agilent E1529A, E1539A, and E1422A Strain Measurement Product Overview*, Pub No. 5968-0432E.

Publication No.: 5965-5585E

Multifunction^{Plus} Measurement and Control Module

Agilent E1419A



Agilent E1419A

- Comprehensive signal conditioning on board
- Wide choice of Input/Output signal types
- Powerful control capability
- On-board data reduction & engineering unit conversion
- Custom on-board DSP program development

Description

The Agilent Technologies E1419A Multifunction^{Plus} Measurement and Control module is a C-size, 1-slot, register-based VXI module. It is ideal for mixed sensor and mixed signal data acquisition and control for design verification of electromechanical components and assemblies.

The flexibility in configuring with multiple Signal Conditioning Plug-ons (SCPs) allows for multiple test setups of mixed signals, both input and output, without adding extra VXI measurement modules. The integrated signal conditioning provides for more accurate and repeatable calibration and eliminates the need for separate signal conditioning carriers. The intelligent measurement and control allows for scalable configurations, on-board Engineering Unit (EU) conversion, and real-time decision making.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Compact Packaging with Signal Conditioning

The E1419A provides for configurable signal conditioned I/O with up to eight individual plug-ons for analog, digital, and frequency needs. The SCPs supported by the E1419A are:

- E1501A 8-Channel Direct Input SCP
- E1502A 8-Channel 7 Hz Low-pass Filter SCP
- E1503A 8-Channel Programmable Filter and Gain SCP
- E1505A 8-Channel Current Source SCP
- E1506A 8-Channel 120 Ω Strain Completion & Excitation SCP
- E1507A 8-Channel 350 Ω Strain Completion & Excitation SCP
- E1508A 8-Channel x16 Gain & 7 Hz Fixed Filter SCP
- E1509A 8-Channel x64 Gain & 7 Hz Fixed Filter SCP
- E1510A 4-Channel Sample & Hold Input SCP
- E1511A 4-Channel Transient Strain SCP
- E1512A 8-Channel 25 Hz Fixed Filter SCP
- E1513A 8-Channel Divide-by-16 Fixed Attenuator & 7 Hz Low-pass Filter SCP
- E1518A 4-Wire Resistance Measurement SCP
- E1531A 8-Channel Voltage Output SCP
- E1532A 8-Channel Current Output SCP
- E1533A 16-Bit Digital I/O SCP
- E1536A 8-Bit Isolated Digital I/O SCP
- E1538A Enhanced Frequency/Totalize/PWM SCP

Wide Choice of Inputs/Outputs

The E1419A has a variety of signal conditioning plug-ons for making measurements of:

- Temperature, strain
- Voltage, current, resistance
- RPM, frequency, totalize
- Discrete levels, TTL, contact closures

In addition, the measured input values and the calculated output values can be stored in a 64,000-sample FIFO buffer and efficiently transferred to the controlling computer in blocks of data. A 500-element current value table is provided so user-written programs can post the latest reading or condition to the controlling computer. The result of any program calculation can be an input for use by another program or subsystem, or it can be a direct output of several different types. Among the choices of output are:

- Analog voltage
- Analog current
- Discrete levels (TTL)
- Programmable pulse width modulation (TTL)

As an example of output flexibility, the pulse width modulation output has several modes. In the PWM free-run mode, the frequency or pulse width output is independent of the update rate and can be changed once per loop update cycle. The square wave mode provides a variable frequency, fixed 50% duty cycle output signal. The pulse-per-update mode provides a variable width pulse synchronized to the update cycle.

Powerful Decision Making Capability

The user-written programs are easily developed from a list of algebraic expressions and flow constructs such as IF-ELSE. Any variable (array or scalar) can be read or written on-the-fly. That is, new values are double-buffered so there is no need to stop scanning the inputs or halt the program execution.

The inputs to user programs can be measured values from multiple channels, operator input values, global variables from other programs, or values from other subsystems.

The on-board 40 MHz pipelined DSP provides highly deterministic execution, making it easy to accurately predict cycle times. Engineering unit conversions for temperature, strain, resistance, and voltage measurements are made automatically without slowing down the algorithm execution speed.

Custom Program Development

Language: subset of C, programming language including if-then-else, most math and comparison operations.

Variable types: scalar local and global variables, array local and global variables.

Intrinsic functions: interrupt(), writefifo(), writecvt(), writeboth(), min(), max(), abs().

Other functions: create your own custom functions to handle transcendental operations.

Automated Calibration for Better Measurements

The E1419A offers superior calibration capabilities that provide more accurate measurements. Periodic calibration of the measurement and control module's measurement inputs is accomplished by connecting an external voltage measurement standard (such as a highly accurate multimeter) to the inputs of the measurement and control module. This external standard first calibrates the on-board calibration source. Then built-in calibration routines use the on-board calibration source and on-board switching to calibrate the entire signal path from the measurement and control module's input, through the signal conditioning plug-ons (SCPs) and FET MUX, to the A/D itself. Subsequent daily or short-term calibrations of this same signal path can be quickly and automatically done using the internal calibration source to eliminate errors introduced by the signal path through the SCPs and FET MUX, or by ambient temperature changes. All input channels can be quickly and productively calibrated to assure continued high-accuracy measurements.

In addition to the calibration of the signal path within the measurement and control module, the E1419A allows you to perform a "Tare Cal" to reduce the effects of voltage offsets and IR voltage drops in your signal wiring that is external to the measurement and control module. The Tare Cal uses an on-board D/A to eliminate these voltage offsets. By placing a short circuit across the signal or transducer being measured, the residual offset can be automatically measured and eliminated by the D/A. Tare Cal should not be used to eliminate the thermoelectric voltage of thermocouple wire on thermocouple channels.

(Agilent E1419A continued)

Signal Conditioning Plug-Ons

A Signal Conditioning Plug-on (SCP) is a small daughter board that mounts on Agilent's VXI scanning measurement and control modules. These SCPs provide a number of input and output functions. Several include gain and filtered analog inputs for measuring electrical and sensor-based signals, as well as frequency, total event count, pulse-width modulation, toothed-wheel velocity, and digital state. Output functions include analog voltage and current D/As, 8- or 16-bit digital outputs, pulse output with variable frequency and PWM, and stepper motor control.

Refer to the information on each individual SCP for more details.

Voltage Measurements

Use any of the following SCPs with the E1419A to make voltage measurements: E1501A, E1502A, E1503A, E1508A, E1509A, E1512A or E1513A.

Temperature Measurements

Any of the input SCPs can be used to make temperature measurements with thermocouples, thermistors, or RTDs, but the E1503A/E1508A/E1509A SCPs provide higher accuracy with thermocouples.

Resistance Measurements

Resistance is measured using either the E1505A 8-Channel Current Source SCP and an input SCP or the E1518A 4-Wire Resistance Measurement SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown.

Static Strain Measurements

The E1506A and E1507A SCPs provide a convenient way to measure a few channels of static strain. When using the E1506A/E1507A for bridge completion, a second SCP is required to make the measurement connection. You can use the following SCPs for this type of static strain measurements:

- E1503A 8-Channel Programmable Filter/Gain SCP
- E1506A 8-Channel 120 Ω Strain Completion & Excitation SCP
- E1507A 8-Channel 350 Ω Strain Completion & Excitation SCP
- E1508A 8-Channel 7 Hz Fixed Filter & x16 Gain SCP
- E1509A 8-Channel 7 Hz Fixed Filter & x64 Gain SCP

For applications requiring more than eight channels of strain measurement, the combination of the Agilent E1422A/E1529A/E1539A provide a more cost effective approach to static (and dynamic) strain measurements.

Transient Measurements

When making higher speed measurements, a vital issue often is the time skew between channels. Ideally, in many applications, the sampled data is needed at essentially the same instant in time. The intrinsic design of the E1419A provides scanning of 64 channels with maximum skew of 640 μ s between the first and last channel, far less than most sampled data systems.

Transient Voltage Measurements

The E1510A provides basic sample-and-hold capabilities on four channels. Six-pole Bessel filters provide alias and alias-based noise reduction while giving excellent transient response without overshoot or ringing. The E1510A can be used in strain applications primarily where the bridge is external.

Transient Strain Measurements

The E1511A, a double-wide SCP, has all the capabilities of the E1510A but adds on-board bridge excitation and completion functions. The four direct input channels are used for monitoring the bridge excitation. A maximum of two SCPs (8 channels) can be installed on an E1419A.

Note: For field wiring, the use of shielded twisted pair wiring is highly recommended.

Analog Output

Use the E1531A for voltage outputs and the E1532A for current outputs. The E1531A and E1532A have eight (8) output channels available on each SCP.

Digital I/O

Use the E1533A Digital I/O SCP to provide two 8-bit input/output words. Use the E1536A Digital I/O SCP to provide one isolated 8-bit input/output word.

Frequency/Totalize/PWM

The E1538A Enhanced Frequency/Totalize/PWM SCP provides eight (8) channels which can be individually configured as a frequency or totalizer input, or as a pulse width modulated output.

Product Specifications**Timing Signals****Timing:**

Scan-to-scan timing and sample-to-sample timing can be set independently.

Scan triggers:

Can be derived from a software command or a TTL level from other VXI modules, internal timer, or external hardware. Typical latency 17.5 μ s. Multiple E1419A modules can be synchronized at the same rate using the TTL trigger output from one E1419A to trigger the others.

Synchronization:

Multiple E1419A modules can be synchronized at different integer-related rates using the ALG:SCAN:RATIO command and the TTL trigger output from one E1419A module to trigger the others.

Alternate synchronization:**Scan Triggers**

Internal:	100 μ sec to 6.5536 sec
Resolution:	100 μ sec
Trigger count:	1 to 65535 or infinite

Sample Timer

Range:	10 μ sec to 32768 msec
Resolution:	0.5 μ sec

Measurement Specifications

The following specifications include the SCP and scanning A/D performance together as a unit. Accuracy is stated for a single sample. Averaging multiple samples will improve accuracy by reducing noise of the signal. The basic E1419A scanning A/D has a full scale range of ± 16 V and five autoranging gains of x1, x4, x16, x64, and x256. An SCP must be used with each eight channel input block to provide input protection and signal conditioning.

Refer to the information on each individual SCP for measurement specifications.

Measurement resolution:	16 bits (including sign)
Maximum reading rate:	Up to 56 kSamples/s dependent upon configuration
Memory:	64 kSa
Maximum input voltage:	Normal mode plus common mode
Operating:	$< \pm 16$ V peak
Damage level:	$> \pm 42$ V peak
Maximum common mode voltage:	
Operating:	$< \pm 16$ V peak
Damage level:	$> \pm 42$ V peak
SCP input impedance:	> 100 M Ω differential
Maximum tare cal offset:	65.5 mV range $\pm 75\%$ of full scale, other ranges $\pm 25\%$ of full scale

Jitter:

Phase jitter scan-to-scan:	80 ps rms
Phase jitter card-to-card:	41 ns peak 12 ns rms

Measurement Accuracy

Typically $\pm 0.01\%$ of input level; varies with the SCP used. Specifications are 90 days, 23 ± 1 $^{\circ}$ C, with *CAL done after a 1 hr warm-up and CAL:ZERO done within 5 minutes.

Note: Beyond the 5 min. limitation and CAL:ZERO not done, apply the following drift error: Drift = 10μ V/ $^{\circ}$ C \div SCP gain, per $^{\circ}$ C change from CAL:ZERO temperature.

Accuracy Data

Measurement accuracy is dependent upon the SCP module used. Refer to the accuracy tables and graphs for the individual SCP to determine the overall measurement accuracy.

Many definitions of accuracy are possible. Here we use single-shot with 3 sigma noise. To calculate accuracy assuming temperature is held constant within ± 1 $^{\circ}$ C of the temperature at calibration, the following formula applies:

$$\text{Single Shot } 3\sigma =$$

$$\pm(\sqrt{(\text{Gain Error})^2 + (\text{Offset Error})^2} + 3\sigma \text{ noise})$$

(Agilent E1419A continued)

Correcting for Temperature

To calculate accuracy over temperature range outside the $\pm 1^\circ\text{C}$ range, results after *CAL are given by replacing each of the above error terms as follows:

Replace
 $(\text{GainError})^2$
 with
 $(\text{GainError})^2 + (\text{GainTempco})^2$
 Replace
 $(\text{OffsetError})^2$
 with
 $(\text{OffsetError})^2 + (\text{OffsetTempco})^2$

Power Available for SCPs

$\pm 24\text{ V}$:	1.0 A
5 V:	3.5 A

General Specifications

VXI Characteristics

VXI device type:	A16, slave only, register based
Data transfer bus:	n/a
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	n/a
VXI buses:	TTL Trigger bus (T)

Instrument Drivers - See the Agilent Technologies Website
 (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/98/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

*The Agilent VEE application can use VXIplug&play drivers or panel drivers.

Cooling/Slot

Watts/slot:	14.00
ΔP mm H ₂ O:	0.08
Air flow liter/s:	0.8

Module Current (with no SCPs installed)

	I_{PM} (A)	I_{DM} (A)
+5 V:	1.0	0.02
+12 V:	0.06	0.01
-12 V:	0	0
+24 V:	0.1	0.01
-24 V:	0.1	0.01
-5.2 V:	0.15	0.01
-2 V:	0	0

Ordering Information

Description	Product No.
Multifunction Plus Measurement and Control	E1419A ^{1, 2}
Delete 4 Direct Input SCP's	E1419A 001
Screw Terminal Block E1419A	E1419A 011
Spring-Clamp Terminal Block	E1419A 013
Interface to Rack Mount Panel	E1419A A3F
Convert 3 yr. Return to 1 yr. OnSite	E1419A W01
8-Channel Direct Input SCP	E1501A**
8-Channel 7 Hz Low-pass Filter SCP	E1502A**
8-Channel Programmable Filter/Gain SCP	E1503A
8-Channel Current Source SCP	E1505A
8-Channel 120 Ω Strain Completion & Excitation SCP	E1506A
8-Channel 350 Ω Strain Completion & Excitation SCP	E1507A
8-Channel x16 Gain & 7 Hz Fixed Filter SCP	E1508A**
8-Channel x64 Gain & 7 Hz Fixed Filter SCP	E1509A**
4-Channel Sample & Hold Input SCP	E1510A
4-Channel Transient Strain SCP	E1511A
8-Channel 25 Hz Fixed Filter SCP	E1512A**
8-Channel $\div 16$ Fixed Attenuator & 7 Hz Low-pass Filter SCP	E1513A**
4-Wire Resistance Measurement SCP	E1518A
8-Channel Voltage Output SCP	E1531A
8-Channel Current Output SCP	E1532A
16-Bit Digital I/O SCP	E1533A
8-Bit Isolated Digital I/O SCP	E1536A
Enhanced Frequency/Totalize/PWM SCP	E1538A

¹Note: No terminal block is included with the E1419A. You must specify a terminal block option when ordering.

²Note: A total of eight (8) Signal Conditioning Plug-ons (SCPs) can be installed in multiple combinations of input or output configurations on a single E1419A. The first four positions support only the non-programmable analog input SCPs (marked with asterisks ["*"] in the Ordering Information table). The E1419A is shipped preconfigured with the E1501A direct inputs in the first four SCP positions. Any non-programmable input SCP marked with asterisks (**) may be substituted by ordering Option 001 with the E1419A, then purchasing the SCP separately.

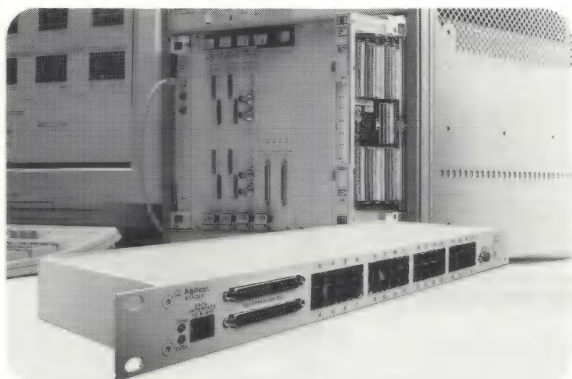
For More Information

For more detailed information on individual SCPs, refer to the corresponding catalog pages for those products, or contact Agilent to request individual data sheets.

Publication No.: 5965-8828E

Remote Strain Conditioning Unit

Agilent E1529A, E1539A



Agilent E1529A

- 32 channels of conditioning in a single rack unit
- Outputs for static-load or dynamic measurements
- Simple, low-cost wiring using RJ-45 telecom connectors
- Locate up to 1,000 ft (330 m) from test system
- Up to 6,144 static channels supported by a single-mainframe VXI system

Description

The Agilent Technologies E1529A Remote Strain Conditioning Unit simplifies structural testing of designs that require many channels of strain measurement. Strain gage cables connect to the E1529A with standard RJ-45 telecom plugs, making it exceptionally easy to reconfigure or replace strain gages.

The E1529A Remote Strain Conditioning Unit is used in a strain measurement system with the E1422A Remote Multifunction Data Acquisition & Control Module, and with E1539A Signal Conditioning Plug-ons (SCPs) for the E1422A. The E1422A is a VXI module that controls the E1529A. Up to 32 strain channels can be connected to each E1529A. Up to two E1529As can be connected to each E1539A, and up to eight E1539As can be mounted on each E1422A. Up to twelve E1422As can be installed in a single-mainframe system, providing up to 6,144 channels of remote strain measurement. The remote E1529As can be located as far as 1000 feet (330 m) from the VXI system containing the E1422A modules. This effectively reduces your wiring costs by nearly 32:1 for testing of large structures.

The E1529A provides fixed 32:1 gain and selectable filtering for each channel. It will handle static signals up to about 400 readings/sec and dynamic signals at alias protected bandwidths of 20 kHz and 88 kHz when used in conjunction with the E1432A and E1433B high-speed digitizers. All this capability is provided in a single 19-inch rackmountable unit that's only one rack unit high (1.75 in).

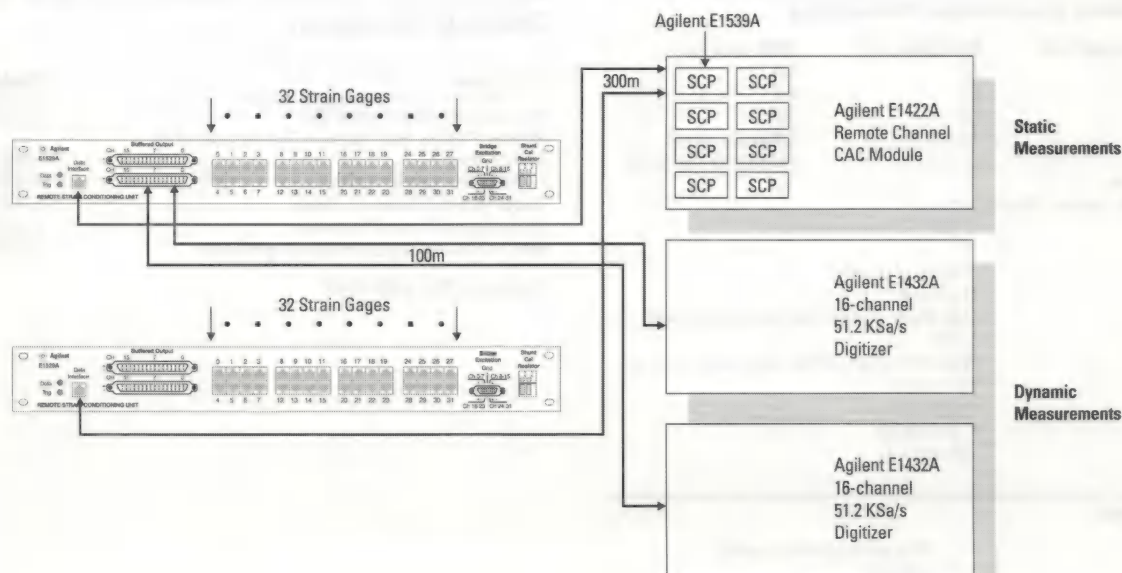
Dynamic signals are cable-connected (32-in, 32-out) without multiplexing to the high-speed digitizers. Static signals are multiplexed (32:1) into the E1422A's high-performance, 100 kHz, 16-bit A/D.

Each channel has bridge-completion and shunt-calibration resistors (with provision for special values). Automatic resetting of fuses ensures that a shorted gage does not disturb any other channel. Up to four external sources can be used to generate the excitation voltages for banks of eight gages.

Automated Calibration for Better Measurements

The E1529A's on-board calibration source, controlled by the E1422A, assures accurate measurements. The E1422A automatically measures this source, calibrating out both gain and offset errors in the signal paths in the E1529A. All these calibration calculations are done in the E1422A on-the-fly while making strain measurements at a rate of 25,000 readings per second.

For more information, please refer to the Agilent Technologies Data Acquisition Website at www.agilent.com/find/data_acq. You can also request Agilent Pub. No. 5968-0432E, *Agilent E1529A, E1539A and E1422A Strain Measurement System Product Overview*.



(Agilent E1529A, E1539A continued)

Product Specifications (E1529A/E1422A/E1539A)

General

Agilent E1529A outputs:	Single static output from 32:1 multiplexer, 32 individually buffered dynamic outputs
Bridge completion:	120 Ω , 350 Ω and custom value, programmatically selectable
Bridge configurations:	Full, half, and quarter
Remote operation:	330 m (1000 ft) from multiplexed output, 100 m (300 ft) from buffered outputs
Bridge excitation:	User-supplied excitation in 8-channel banks
Linearization:	mx+b on all channels
Calibration:	Internal self-calibration source 50 k Ω and user-installed shunt calibration resistor, program selectable
Measurement rate:	25 kSa/s via multiplexed output, up to 196 kSa/s dynamic
Static (multiplexed) outputs:	
Gain (E1529A only):	32 V per V
Gain (E1529A + E1422A):	5000 V per V
Resolution (1 LSB of E1422A):	0.06 μ V (subject to RMS noise limits)
Recommended measurement products:	Note: Companion products listed below are VXI-based. Twelve measurement module slots are typically available in systems using any one of Agilent's available 13-slot VXI mainframes.
Static strain measurements:	E1422A Remote Channel DAC Module plus up to eight E1539A SCPs
Dynamic strain measurements:	E1432A 16-Channel 51.2 kSa/s Digitizer E1433A 8-Channel 196 kSa/s Digitizer

Bridge Specifications

Completion resistors:	
Values:	120 Ω /350 Ω \pm 0.05%, \pm 5 ppm/ $^{\circ}$ C TC
Power:	0.125 W up to 125 $^{\circ}$ C
Shunt cal resistor:	50 k Ω \pm 0.1%, \pm 25 ppm/ $^{\circ}$ C TC
Quarter bridge offset:	3 μ strain (\pm 2 μ V), \pm 4 $^{\circ}$ C of tare cal
Excitation sense:	
Gain accuracy:	\pm 0.01% of reading
Offset:	<1 mV

Strain Measurement (Quarter bridge, \pm 5V excitation)

Measurement range (μ ϵ)	Resolution (μ ϵ)	RMS noise (μ ϵ)
\pm 200,000	6.1	0.4
\pm 50,000	1.5	0.4
\pm 12,500	0.4	0.4
\pm 3,125	0.1	0.4 (noise can be reduced by averaging)

System accuracy:

(Note: After CAL routine, 1 hour warm-up, \pm 1 $^{\circ}$ C)	
Voltage offset:	<2 μ V
Gain error:	<0.015% of reading
RMS Noise:	<1 μ V rms
CMRR:	>100 dB, dc-10 MHz (common mode range \pm 10V)
Drift:	(Note: drift errors can be removed by running CAL routine)
Offset drift:	<1 μ V/ $^{\circ}$ C
	<1 μ V/month
Gain drift:	<30 ppm/ $^{\circ}$ C

Dynamic outputs

Gain:	32 V per V \pm 0.1% of reading
Offset:	>250 μ V
Bandwidth:	>100 kHz
Equivalent input noise (E.I.N.):	<20 nV/ \sqrt Hz

Quarter Bridge Bending Errors (5 V Excitation, GF=2)

μ ϵ	Error (μ ϵ)
0	1
\pm 10,000	8
\pm 20,000	20
\pm 30,000	45
\pm 40,000	90
\pm 50,000	160

Half Bridge Bending Errors (5 V Excitation, GF=2)

μ ϵ	Error (μ ϵ)
0	0.5
\pm 10,000	6
\pm 20,000	12
\pm 30,000	17
\pm 40,000	23
\pm 50,000	28

Full Bridge Bending Errors (5 V Excitation, GF=2)

μ ϵ	Error (μ ϵ)
0	0.3
\pm 10,000	6
\pm 20,000	11
\pm 30,000	17
\pm 40,000	22
\pm 50,000	28

E1529A Mechanical/Power/Environmental

Height:	4.45 cm (1.75 in)
Width:	49.53 cm (19.5 in)
Weight:	1.8 Kg (4 lbs)
Line voltage:	90 - 264 Vac
Line frequency:	47 - 440 Hz
Input power:	8 W
Temperature:	-5 $^{\circ}$ C to +55 $^{\circ}$ C
Humidity:	5 to 85% R.H.
Altitude:	10,000 ft operating 30,000 ft non-operating

Ordering Information

Description	Product No.
Remote Strain Conditioning Unit	E1529A
Remote Channel Multi-function Data Acquisition & Control Module	E1422A
16-Port RJ-45 Connector Block	E1422A 001
Screw Terminal Connector Block	E1422A 011
Spring Clamp Terminal Connector	E1422A 013
Remote Channel Signal Conditioning Plug-on	E1539A

Publication No.: 5963-9650E

SCP Selection Guide

The Scanning A/D and Closed Loop Control module family delivers a wide variety of analog and digital measurement capability as well as stimulus/control through the use of Signal Conditioning Plug-ons (SCPs). This table can help guide your selection of SCPs based on your measurement application. You can obtain detailed SCP specifications in this section of this catalog, and on the Agilent Technologies Website (www.agilent.com/find/tmdir). Data Sheets for these products are also available through your Agilent Sales Representative, or by contacting the nearest Agilent Sales Office or Service/Support Center.

SCP Selection Table - Measurements

Sensor Measurements	E1501A Direct Input, 8 Ch	E1502A 10Hz Low Pass Filter, 8 Ch	E1503A Prog Gain/Filt, 8 Ch	E1504A Prog Current Source, 8 Ch	E1507A 120C Static Strain, 8 Ch	E1508A 100k Static Strain, 8 Ch	E1509A 10k Gain 10Hz Filter, 8 Ch	E1510A 10k Gain 10Hz Filter, 8 Ch	E1511A Sample and Hold, 4 Ch	E1512A 25Hz Low Pass Filter, 4 Ch	E1513A Divide by 16, 8-bit, 8 Ch	E1514A 4-Wire Resistance	E1515A Remote Channel SCP
Maximum Sensor Voltage													
+/-60V													
+/-16V	•	•	•					•	•	•			
+/-2V			•					•	•				
+/-1V					•							•	
+/-0.25V			•				•	•	•				
+/-0.032V							•	•					
T/C Temperature	•	•	•		•	•			•				
RTD Temperature	•	•	•	•	•	•			•		•		
Thermistor Temperature	•	•	•	•	•	•			•		•		
Resistance	•	•	•		•	•			•		•		
Static Strain	•	•	•	•	•	•			•			•	
Transient Strain								•				•	
Fast Voltage Sampling							•						
Scanning A/D Compatibility													
E1413C	•	•	•	•	•	•	•	•	•	•	•	•	
E1415A	•	•	•	•	•	•	•	•	•	•	•	•	
E1419A	•	•	•	•	•	•	•	•	•	•	•	•	
E1422A	•	•	•	•	•	•	•	•	•	•	•	•	•

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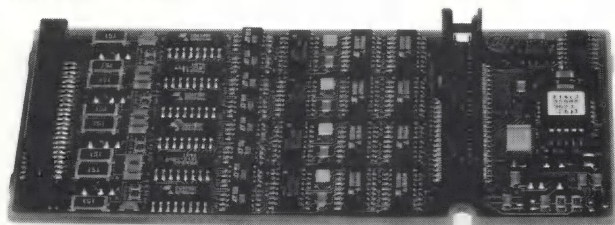
SCP Selection Table - Stimulus/Measurement/Control

Other Measurements	E1501A Voltage Output, 8 Ch	E1502A Current Output, 8 Ch	E1503A Digital I/O, 2x8-bit, 8 Ch	E1504A Isolated 8-bit Digital I/O	E1505A Enhanced Frequency/Tone/FWM
Digital Input			•	•	•
Frequency					•
Total Count					•
Debounce			•		
Pulse Width					•
Toothed Wheel Velocity					•
Variable Reluctance					•
Control Outputs					
Voltage Source	•				
Current Source		•			
Digital Output			•	•	•
Variable Frequency Pulse					•
Variable Pulse Width					•
Stopper Motor					•
Crank Angle					•
Scanning A/D Compatibility					
E1413C					
E1415A	•	•	•	•	•
E1419A	•	•	•	•	•
E1422A	•	•	•	•	•

Publication No.: Not available

8-Channel Voltage Input SCPs

Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A



Agilent E1503

- Different signal gains to match different input signal levels
- Signal filtering to reduce sensor-based noise
- SCPs provide over-voltage protection
- SCPs provide open transducer detection
- Use any of these SCPs with the Agilent E1413C/E1415A/E1419A/E1422A Scanning A/Ds

Agilent E1501A	Direct Input
Agilent E1502A	7 Hz Low-Pass Filter
Agilent E1503A	Programmable Filter/Gain
Agilent E1508A	x16 Gain & 7 Hz Low-Pass Filter
Agilent E1509A	x64 Gain & 7 Hz Low-Pass Filter
Agilent E1512A	25 Hz Low-Pass Filter
Agilent E1513A	Divide-by-16 Attenuator & 7 Hz Low-Pass Filter

You can choose different Signal Conditioning Plug-ons (SCPs) for different groups of signals, based on the signal levels and characteristics. Each SCP is optimized for different input levels, and some of these SCPs have filtering to reduce sensor-based noise. Each SCP has eight input channels. Multiple SCPs can be combined on the Scanning A/D to provide the proper signal conditioning for a wide variety of inputs. Each of these SCPs provides input over-voltage protection. Each SCP, except for the E1513A, provides open transducer detection on each channel.

Measurement applications of these SCPs include voltage, temperature, resistance, and strain measurements, and general measurements of voltage output sensors.

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Voltage Input SCP Selection Guide

E1501A Direct Input (>100 kHz BW) SCP	<ul style="list-style-type: none"> • provides eight hardwired paths that directly connect the input signal to the FET MUX of the scanning A/D (the most basic SCP)
E1502A 8-Channel Low-Pass Filter SCP	<ul style="list-style-type: none"> • provides eight fixed, 2-pole, low-pass filters with a 3 dB cutoff frequency of 7 Hz
E1503A 8-Channel Programmable Filter/Gain SCP	<ul style="list-style-type: none"> • provides eight programmable, 2-pole, low-pass filters with cutoff frequency settings of 2, 10, and 100 Hz, as well as a 1.5 kHz "pass-through" mode (filter OFF) • eight programmable input amplifiers provide input voltage ranges of ± 0.25 V, ± 2 V, and ± 16 V
E1508A 8-Channel x16 Gain & 7 Hz Fixed Filter SCP	<ul style="list-style-type: none"> • provides eight fixed, 2-pole, low-pass filters with a 3 dB cutoff frequency of 7 Hz • eight amplifiers with a fixed gain of 16
E1509A 8-Channel x64 Gain & 7 Hz Fixed Filter SCP	<ul style="list-style-type: none"> • provides eight fixed low-pass filters with a 3 dB cutoff frequency of 7 Hz • eight amplifiers with a fixed gain of 64
E1512A 8-Channel 25 Hz Fixed Filter SCP	<ul style="list-style-type: none"> • provides eight fixed low-pass filters with a 3 dB cutoff frequency of 25 Hz (no gain)
E1513A 8-Channel $\div 16$ Attenuator & 7 Hz Fixed Filter SCP	<ul style="list-style-type: none"> • provides eight fixed low-pass filters with a 3 dB cutoff frequency of 7 Hz • eight attenuators with a fixed attenuation of 16

Use the E1501/02/03/08/09/12/13A SCPs with the following VXI modules:

Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module (only in SCP positions 5 - 8)
E1422A	Remote Channel Multi-function DAC Module

Voltage Measurements

Each SCP is optimized for different input voltage levels, with some SCPs providing filtering to reduce sensor-based noise.

E1501A	Measure wide bandwidth signals (no filtering, no gain) from sensors with full-scale voltage outputs from 62 mV to 16 V.
E1502A	Measure signals from sensors with full-scale voltage outputs from 62 mV to 16 V. Fixed 2-pole, 7 Hz low-pass filter (no gain) per channel.
E1503A	Measure signals from sensors with full-scale voltage outputs from 3.9 mV to 16 V. Programmable 2-pole, low-pass filters (3 dB BWs of 2, 10, or 100 Hz) can be switched into each channel. Each channel can have a gain of x1, x8, or x64.
E1508A	Measure signals from sensors with full-scale voltage outputs from 3.9 mV to 1 V. Fixed 2-pole 7 Hz low-pass filter and x16 gain per channel.
E1509A	Measure signals from sensors with full-scale voltage outputs from 3.9 mV to 256 mV. Fixed 2-pole, 7 Hz low-pass filter and x64 gain per channel.
E1512A	Measure signals from sensors with full-scale voltage outputs from 62 mV to 16 V. Fixed 2-pole, 25 Hz low-pass filter (no gain) per channel.
E1513A	Measure voltages from ± 1 Vdc to ± 60 Vdc. Fixed $\div 16$ attenuator and fixed 2-pole, 7 Hz low-pass filter per channel.

(Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A continued)

Temperature Measurements

The E1501/02/03/08/09/12A can be used to make temperature measurements with thermocouples, thermistors, or RTDs. Engineering units conversion to degrees C are made on-card at full speed. While the E1501/02/12A can directly read thermocouples, the E1503A/E1508A/E1509A SCPs provide higher accuracy thermocouple measurements due their on-board signal gain. (Note: The 256 mV maximum voltage input of the E1509A is not high enough to measure the on-board thermistor reference temperature. A higher-voltage SCP must be used for this thermistor measurement.)

Temperature measurements with thermistors or RTDs require one E1505A 8-Channel Current Source SCP to be used with each voltage input SCP. The E1513A is not recommended for temperature measurements with low-output-level transducers such as thermocouples, thermistors, and RTDs.

Resistance Measurements

Resistance is measured using the E1505A Current Source SCP with the E1501/02/03/08/09/12A SCPs. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown resistance. The current source is provided through the E1505A. The recommended 4-wire Ω configuration is shown in the description of the E1505A Current Source SCP. Two-wire measurements are possible but not recommended since two 150 Ω series resistors protecting the scanning A/D's input FET multiplexer are included in the measurements.

Strain Measurements

These SCPs can be used to make strain measurements when combined with either the E1506A or E1507A Strain Completion SCPs. While the E1501/02/12A SCPs can be used for strain gage measurements, the E1503A, E1508A and E1509A SCPs provide higher accuracy strain measurements due to their on-board signal gain.

Product Specifications

These specifications for the E1501/02/03/08/09/12/13A reflect the combined performance of the scanning A/D and the E1501/02/03/08/09/12/13A SCP.

Measurement Ranges

dc Volts:

E1501/02/12A:	± 62.5 mV to ± 16 V full scale
E1503A:	± 3.9 mV to ± 16 V full scale
E1508A:	± 3.9 mV to ± 1 V full scale
E1509A:	± 3.9 mV to ± 256 mV full scale
E1513A:	± 1 V to ± 60 V full scale

Resistance*:

E1501A:	512 Ω to 131 k Ω FS
E1502/09/12A:	128 Ω to 131 k Ω FS
E1503A:	8 Ω to 131 k Ω FS
E1508A:	8 Ω to 32.7 k Ω FS

Temperature:

Thermocouples:	-200 to +1700° C
Thermistors*:	-80 to +160° C
RTDs*:	-200 to +850° C
Strain**:	25,000 $\mu\epsilon$ or limit of linear range of strain gage

* Requires Agilent E1505A.

** Requires Agilent E1506A/E1507A

Input Characteristics

Maximum input voltage (normal mode plus common mode):

Operating:	$< \pm 16$ V peak (E1513A: ± 60 Vdc)
Damage level:	$> \pm 42$ V peak (E1513A: ± 60 Vdc*)

Maximum common mode voltage

Operating:	$< \pm 16$ V peak (E1513A: ± 60 Vdc)
Damage level:	$> \pm 42$ V peak (E1513A: ± 60 Vdc*)
(* 60 Vdc is the max. voltage allowed by Agilent safety guidelines for the SCP connector pin spacing at max. operating temperature and humidity.)	

Normal mode rejection:

E1501A:	0 dB
E1502/08A (10 Hz LPF) 10 Hz:	-6 dB
E1502/08A (10 Hz LPF) 50 Hz:	> -23 dB
E1502/08A (10 Hz LPF) 60 Hz:	> -25 dB
E1512A (25 Hz LPF) 25 Hz:	-3 dB
E1512A (25 Hz LPF) 60 Hz:	> -20 dB
E1513A (7 Hz LPF) 7 Hz:	-3 dB
E1513A (7 Hz LPF) 50 Hz:	> -24 dB
E1513A (7 Hz LPF) 60 Hz:	> -27 dB

Common mode rejection, 0 to 60 Hz:

E1501A:	> -105 dB
E1502/08/12A min.:	> -100 dB
E1502/08/12A typ.:	> -108 dB
E1503A Gain x1:	> -100 dB
E1503A Gain x8:	> -116 dB
E1503A Gain x64:	> -132 dB
E1509A:	> -100 dB
E1513A:	> -60 dB
Input impedance:	> 100 M Ω differential (E1513A: 1 M Ω differential)

Input capacitance:

E1501A:	80 pF typical
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Measurement Accuracy dc Volts

$$\text{Total dc Voltage Error} = [(\text{Linearity error})^2 + (\text{Offset error})^2 + (\text{Noise})^2]^{1/2}$$

*For the E1501/02/03/08/09/12A, if autoranging is ON, add $\pm .02\%$ of Full Scale to accuracy specifications.

*For the E1513A, if autoranging is ON, add $\pm .05\%$ of reading for input voltages $> \pm 4$ Vdc.

E1501A (x1 Gain)

A/D Range \pm V FS	Linearity % of Reading	Offset Error	Noise 3 σ	Noise* 3 σ
.0625	0.01%	5.3 μ V	18 μ V	8 μ V
.25	0.01%	10.3 μ V	45 μ V	24 μ V
1	0.01%	31 μ V	110 μ V	90 μ V
4	0.01%	122 μ V	450 μ V	366 μ V
16	0.01%	488 μ V	1.8 mV	1.5 mV

* A/D filter ON (min sample period ≥ 145 μ s; ≤ 100 Hz scan rate 64 ch).

Temperature Coefficients

	Temp Range	Tempco
Gain:		10 ppm/°C
Offset:	0-40° C	0.14 μ V/°C
	40-55° C	0.38 μ V/°C + 0.8 μ V

E1502A/E1512A (x1 Gain)

A/D Range \pm V FS	Linearity % of Reading	Offset Error	Noise 3 σ	Noise* 3 σ
.0625	0.01%	7.2 μ V	34 μ V	15 μ V
.25	0.01%	12.2 μ V	60 μ V	28 μ V
1	0.01%	33 μ V	110 μ V	92 μ V
4	0.01%	122 μ V	450 μ V	366 μ V
16	0.01%	488 μ V	1.8 mV	1.5 mV

* A/D filter ON (min sample period ≥ 145 μ s; ≤ 100 Hz scan rate 64 ch).

(Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A continued)

Temperature Coefficients

	Temp Range	Tempco
Gain:		10 ppm/°C
Offset:	0-30° C	No added error
	30-40° C	0.1 μ V/°C
	40-55° C	0.27 μ V/°C + 2.4 μ V

E1503A (x1 Gain)

A/D Range \pm V FS	Linearity % of Reading	Offset Error				Noise 3 σ	Noise* 3 σ
		2 Hz	10 Hz	100 Hz	Filt Off		
.0625	0.01%	13 μ V	9.5 μ V	6.8 μ V	6.3 μ V	45 μ V	26 μ V
.25	0.01%	15 μ V	12.5 μ V	11.2 μ V	10.8 μ V	63 μ V	31 μ V
1	0.01%	33 μ V	31.8 μ V	31.3 μ V	31.2 μ V	112 μ V	93 μ V
4	0.01%	123 μ V	122 μ V	122 μ V	122 μ V	450 μ V	366 μ V
16	0.01%	488 μ V	488 μ V	488 μ V	488 μ V	1.8 mV	1.5 mV

*A/D filter ON (min sample period \geq 145 μ s; \leq 100 Hz scan rate 64 ch).

Temperature Coefficients

For offset, add Tempco and fixed offset to the offset above.

	Temp Range	Tempco	2 Hz	10 Hz	100 Hz	Filt Off
Gain:		15 ppm/°C				
Offset:	0-30° C	0.16 μ V/°C	0 μ V	0 μ V	0 μ V	0 μ V
	30-40° C	0.18 μ V/°C	13 μ V	9 μ V	1.1 μ V	0.2 μ V
	40-55° C	0.39 μ V/°C	31 μ V	22 μ V	6.4 μ V	1.1 μ V

E1503A (x8 Gain)

A/D Range \pm V FS	Linearity % of Reading	Offset Error				Noise 3 σ	Noise* 3 σ
		2 Hz	10 Hz	100 Hz	Filt Off		
.0078	0.01%	4.6 μ V	4.2 μ V	3.8 μ V	3.7 μ V	5.8 μ V	4.9 μ V
.031	0.01%	4.8 μ V	4.6 μ V	4.4 μ V	4.3 μ V	6.9 μ V**	5.9 μ V**
.125	0.01%	6 μ V	5.3 μ V	5 μ V	4.9 μ V	14 μ V	12 μ V
.5	0.01%	16 μ V	16 μ V	16 μ V	16 μ V	56 μ V	46 μ V
2	0.01%	61 μ V	61 μ V	61 μ V	61 μ V	225 μ V	188 μ V

*A/D filter ON (min sample period \geq 145 μ s; \leq 100 Hz scan rate 64 ch).** 7.4 μ V and 6.3 μ V when temperature \geq 40° C

Temperature Coefficients

For offset, add Tempco and fixed offset to the offset above.

	Temp Range	Tempco	2 Hz	10 Hz	100 Hz	Filt Off
Gain:		15 ppm/°C				
Offset:	0-30° C	0.16 μ V/°C	0 μ V	0 μ V	0 μ V	0 μ V
	30-40° C	0.18 μ V/°C	4.3 μ V	2.7 μ V	1 μ V	0.2 μ V
	40-55° C	0.39 μ V/°C	13 μ V	10 μ V	6.2 μ V	0.8 μ V

E1503A (x64 Gain)

A/D Range \pm V FS	Linearity % of Reading	Offset Error				Noise 3 σ	Noise* 3 σ
		2 Hz	10 Hz	100 Hz	Filt Off		
.0039	0.01%	2.9 μ V	2.3 μ V	2.1 μ V	2.1 μ V	1.6 μ V**	1.3 μ V**
.0156	0.01%	3 μ V	2.4 μ V	2.2 μ V	2.2 μ V	2.2 μ V***	1.9 μ V***
.0625	0.01%	3.5 μ V	3 μ V	2.9 μ V	2.9 μ V	7 μ V	5.7 μ V
.25	0.01%	8.2 μ V	8 μ V	8 μ V	8 μ V	28 μ V	23 μ V

*A/D filter ON (min sample period \geq 145 μ s; \leq 100 Hz scan rate 64 ch).** 1.9 μ V and 1.7 μ V for 100 Hz filter*** 2.5 μ V and 2.2 μ V when temperature \geq 40° C

Temperature Coefficients

For offset, add Tempco and fixed offset to the offset above

	Temp Range	Tempco	2 Hz	10 Hz	100 Hz	Filt Off
Gain:		15 ppm/°C				
Offset:	0-30° C	0.16 μ V/°C	0 μ V	0 μ V	0 μ V	0 μ V
	30-40° C	0.18 μ V/°C	1.1 μ V	0.2 μ V	0.1 μ V	0.1 μ V
	40-55° C	0.39 μ V/°C	6 μ V	1.4 μ V	0.6 μ V	0.6 μ V

E1508A (x16 Gain)

Fixed Gain x16 Range \pm V FS	Linearity % of Reading	Offset Error	Noise 3 σ	Noise* 3 σ
.0039	0.01%	3.8 μ V	3.4 μ V	2.9 μ V
.0156	0.01%	4.2 μ V	4.4 μ V	3.8 μ V
.0625	0.01%	4.9 μ V	7.5 μ V	6.3 μ V
.256	0.01%	8 μ V	28 μ V	23 μ V
1.0	0.01%	31 μ V	113 μ V	64 μ V

*A/D filter ON (min sample period \geq 145 μ s; \leq 100 Hz scan rate 64 ch).

Temperature Coefficients

	Temp Range	Tempco
Gain:		15 ppm/°C
Offset:	0-30° C	0.16 μ V/°C
	30-40° C	0.18 μ V/°C
	40-55° C	0.39 μ V/°C

E1509A (x64 Gain)

Fixed Gain x64 Range \pm V FS	Linearity % of Reading	Offset Error	Noise 3 σ	Noise* 3 σ
.0039	0.01%	2.3 μ V	1.7 μ V	1.4 μ V
.0156	0.01%	2.4 μ V	2.5 μ V	2.2 μ V
.0625	0.01%	3.0 μ V	7.0 μ V	5.7 μ V
.256	0.01%	8.0 μ V	28 μ V	23 μ V

*A/D filter ON (min sample period \geq 145 μ s; \leq 100 Hz scan rate 64 ch).

Temperature Coefficients

	Temp Range	Tempco
Gain:		15 ppm/°C
Offset:	0-30° C	0.16 μ V/°C
	30-40° C	0.18 μ V/°C
	40-55° C	0.39 μ V/°C

E1513A (\div 16 Attenuation)

A/D Range \pm V FS	Linearity % of Reading	Common Mode Error % of Vcm	Offset Error	Noise 3 σ	Noise* 3 σ
0.0625** (1 V)	0.02%	0.1%	100 μ V	700 μ V	280 μ V
0.25** (4 V)	0.02%	0.1%	175 μ V	860 μ V	430 μ V
1 (16 V)	0.02%	0.1%	500 μ V	1.8 mV	1.4 mV
4 (60 V)	0.02%	0.1%	1.95 mV	7.0 mV	5.8 mV

*A/D filter ON (min sample period \geq 145 μ s; \leq 100 Hz scan rate 64 ch).

** These ranges are not recommended.

Temperature Coefficients

	Temp Range	Tempco
Gain:		0.001/°C
Offset:	0-40° C	0.14 mV/°C
	40-55° C	0.8 mV + 0.38 mV/°C

(Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A continued)

Maximum Tare Cal Offset

This is the maximum voltage offset the effect of which can be eliminated by the Tare Cal D/A on the Scanning A/D. Maximum tare cal offset depends on A/D range and SCP gain.

A/D Range ±V FS	E1501A E1502A E1503A E1512A	E1503A	E1508A	E1503A E1509A	E1513A
	Gain x1	Gain x8	Gain x16	Gain x64	Atten ÷16
0.0625V	0.03792V	0.00312V	0.00112V	n/a	0.606V
0.25V	0.07581V	0.00786V	0.00349V	0.00055V	1.212V
1V	0.23061V	0.02721V	0.01317V	0.00297V	3.689V
4V	0.82101V	0.10101V	0.05007V	0.01220V	13.13V
16V	3.2213V	0.40104V	0.20009V	0.04970V	49.95V

Temperature Measurement Accuracy

The thermocouple graphs and tables following this description include the errors due to measuring the voltage output of the thermocouple, and the algorithm errors due to converting the thermocouple voltage to temperature; this is the Measurement/Conversion Error (MCE). To this error the Reference Junction Measurement Error (RJME) must be added due to measuring the reference junction temperature with an RTD or thermistor (this measurement requires an E1505A). Also, the Isothermal Reference Gradient Errors (IRGE) must be added due to gradients across the isothermal reference. If an external isothermal reference panel is used, consult the manufacturer's specifications. If Agilent terminal blocks are used as the isothermal reference, see the notes below.

$$\text{Total Temperature Error} = [(MCE)^2 + (RJME)^2 + (IRGE)^2]^{1/2}$$

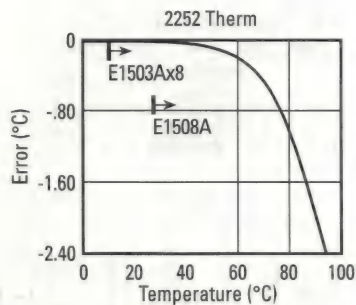
The following temperature accuracy graphs and tables include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS-90 transducer curves. Add your transducer accuracy to determine total measurement error.

Most of the following temperature accuracy graphs and tables show the Measurement Conversion Error (MCE) for the applicable combination of SCP and transducer. The graphs and tables marked "REF" show the Reference Junction Measurement Error (RJME) for the combination of SCP and either Thermistor or RTD reference junction measurement.

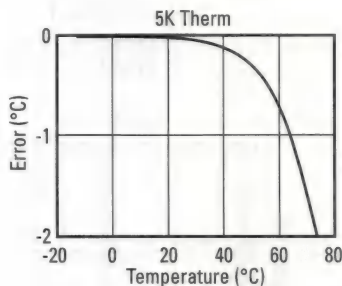
All specifications for the following graphs are with the A/D filter off.

For Isothermal Reference Gradient Errors (IRGE), use the following guidelines.

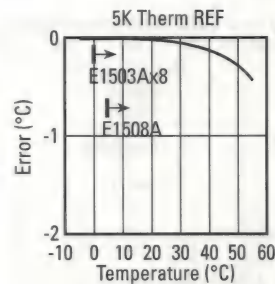
1. When using the Terminal Block as the isothermal reference, add $\pm 0.6^\circ\text{C}$ to the thermocouple accuracy specs to account for temperature gradients across the Terminal Block. The ambient temperature of the air surrounding the Terminal Block must be within $\pm 2^\circ\text{C}$ of the temperature of the inlet cooling air to the VXI mainframe.
2. When using the Agilent E1586A Rack Mount Terminal Panel as the isothermal reference, add $\pm 0.2^\circ\text{C}$ to the thermocouple accuracy specs to account for temperature gradients across the E1586A. The E1586A should be mounted in the bottom part of the rack, below and away from other heat sources, for best performance.



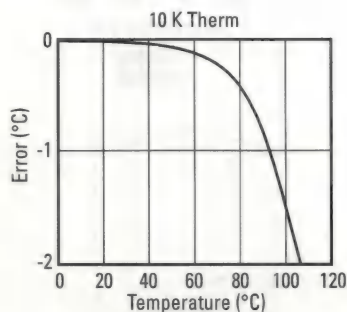
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— E1502A
— E1503Ax8
— E1508A



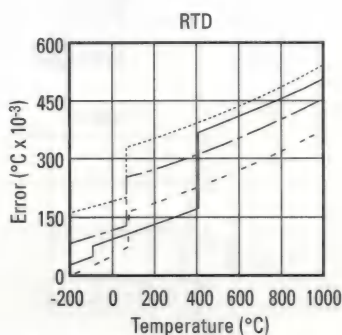
— E1501A
— E1502A
— E1503Ax8
— E1508A



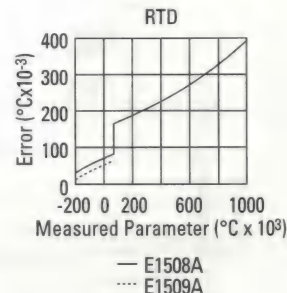
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— E1503Ax8
— E1508A



— E1501A
— E1502A
— E1503Ax8
— E1508A

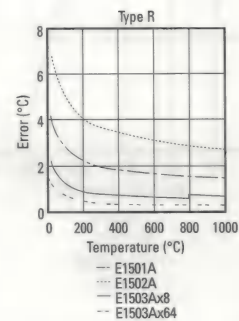
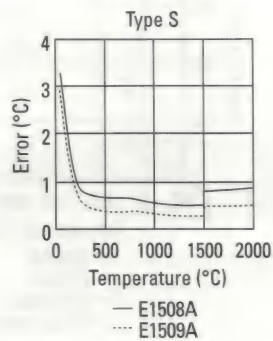
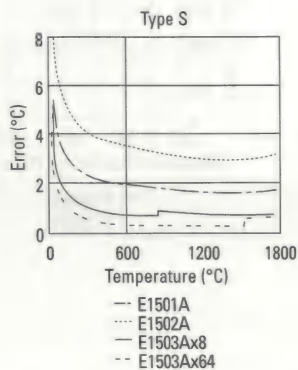
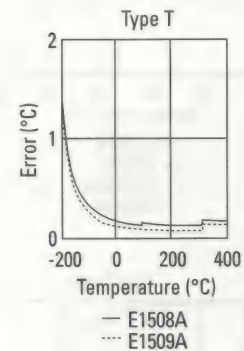
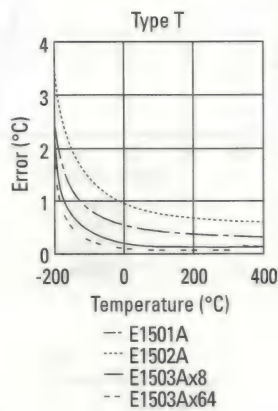
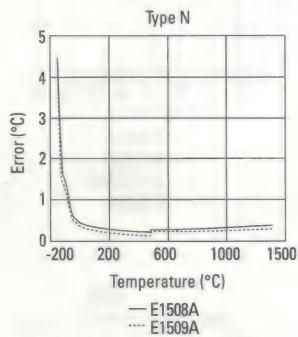
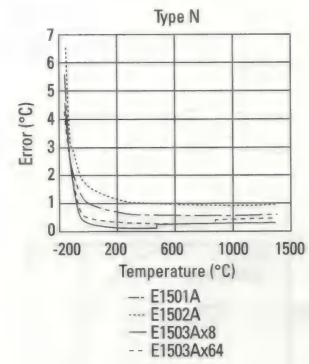
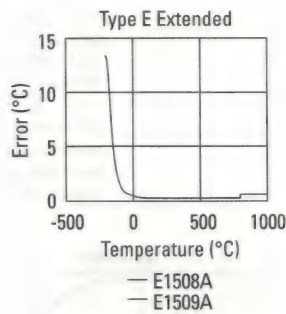
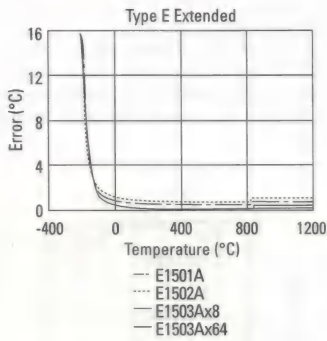
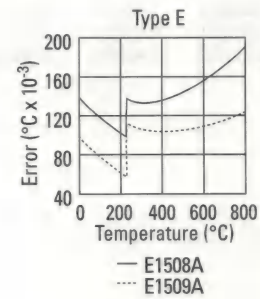
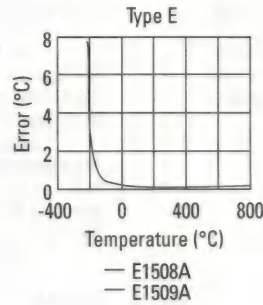
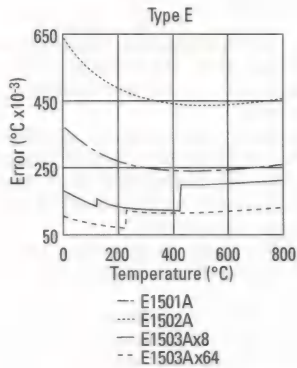
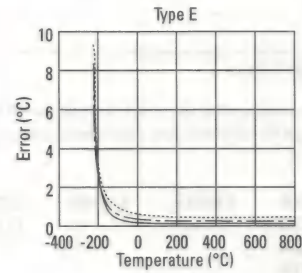
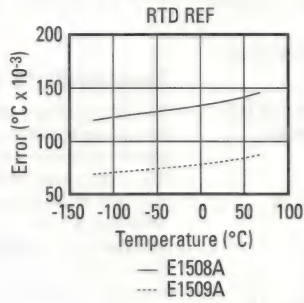
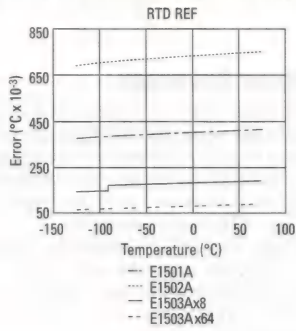


— E1501A
— E1502A
— E1503Ax8
— E1503Ax64

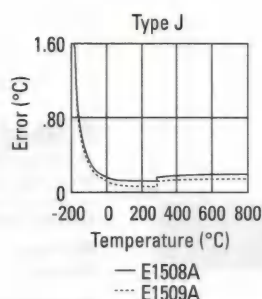
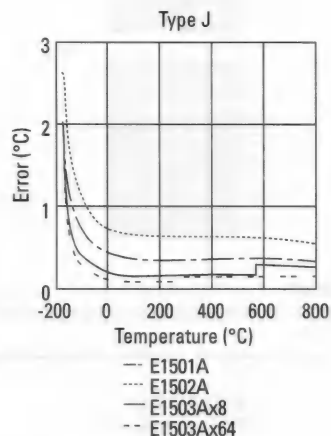
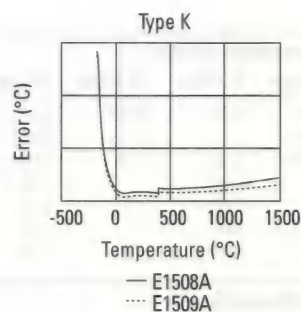
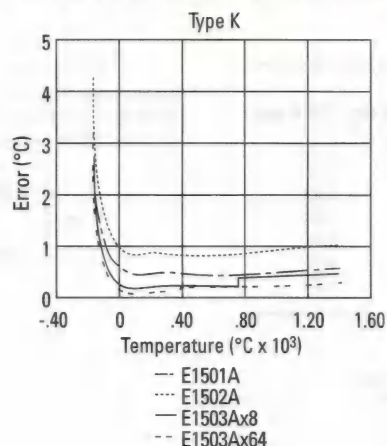
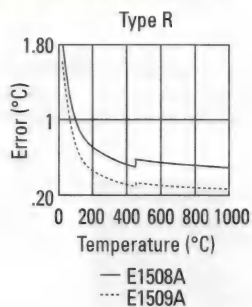


— E1508A
— E1509A

(Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A continued)



(Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A continued)



E1512A Thermistor Measurement Accuracy

2252Ω

A/D Filter:	0 to 30° C	30 to 70° C	70 to 80° C	80 to 100° C:
OFF:	0.012° C	0.013° C	0.014° C	0.024° C
ON*:	0.010° C	0.012° C	0.010° C	0.014° C

5 kΩ

A/D Filter:	0 to 30° C	30 to 70° C	70 to 85° C:
OFF:	0.014° C	0.027° C	0.048° C
ON*:	0.011° C	0.017° C	0.027° C

5 kΩ Reference

A/D Filter:	-10 to 65° C	65 to 85° C:
OFF:	0.011° C	0.021° C
ON*:	0.0095° C	0.0115° C

10 kΩ

A/D Filter:	0 to 30° C	30 to 60° C	60 to 90° C	90 to 115° C:
OFF:	0.015° C	0.024° C	0.034° C	0.059° C
ON*:	0.013° C	0.016° C	0.021° C	0.032° C

E1512A RTD Measurement Accuracy

100Ω

A/D Filter:	-200 to 75° C	75 to 300° C	300 to 600° C	600 to 970° C
OFF:	0.19° C	0.37° C	0.43° C	0.53° C
ON*:	0.11° C	0.21° C	0.36° C	0.46° C

100Ω Reference

A/D Filter:	-125 to 75° C
OFF:	0.75° C
ON*:	0.36° C

E1512A Thermocouple Measurement Accuracy

Type E

A/D Filter:	-200 to 0° C	0 to 200° C	200 to 400° C	400 to 800° C
OFF:	2.25° C	0.65° C	0.50° C	0.45° C
ON*:	1.65° C	0.34° C	0.24° C	0.23° C

Type E Extended

A/D Filter:	-200 to 0° C	0 to 200° C	200 to 600° C	600 to 800° C
OFF:	14.7° C	0.80° C	0.50° C	0.80° C
ON*:	13.8° C	0.49° C	0.30° C	0.45° C

Type T

A/D Filter:	-200 to -100° C	-100 to 0° C	0 to 200° C	200 to 400° C
OFF:	3.40° C	1.90° C	0.90° C	0.70° C
ON*:	2.25° C	0.78° C	0.46° C	0.33° C

Type S

A/D Filter:	0 to 100° C	100 to 200° C	200 to 800° C	800 to 1750° C
OFF:	8.00° C	5.60° C	4.45° C	3.30° C
ON*:	5.20° C	3.25° C	2.40° C	1.60° C

Type R

A/D Filter:	0 to 100° C	100 to 200° C	200 to 600° C	600 to 1000° C
OFF:	6.90° C	5.00° C	4.00° C	3.10° C
ON*:	3.80° C	2.60° C	1.95° C	1.70° C

Type K

A/D Filter:	-200 to 0° C	0 to 400° C	400 to 800° C	800 to 1400° C
OFF:	4.30° C	0.90° C	0.85° C	1.10° C
ON*:	3.35° C	0.50° C	0.40° C	0.52° C

Type J

A/D Filter:	-200 to 0° C	0 to 200° C	200 to 600° C	600 to 775° C
OFF:	2.65° C	0.75° C	0.63° C	0.63° C
ON*:	2.00° C	0.38° C	0.32° C	0.32° C

* [SENSe:]FILTer[:LPASs][:STATe] ON (max scan rate > 100 rdgs/sec/channel)

(Agilent E1501A, E1502A, E1503A, E1508A, E1509A, E1512A, E1513A continued)

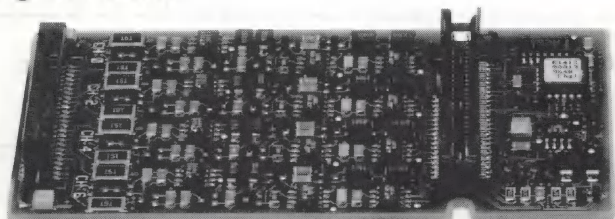
Current Requirements (Amps)

	5 V typ	5 V max	24 V typ	24 V max	-24 V typ	-24 V max
E1501A:	0.01	0.01	0.006	0.01	0.006	0.01
E1502A:	0.01	0.01	0.015	0.02	0.015	0.02
E1503A:	0.01	0.01	0.04	0.06	0.04	0.06
E1508A:		0.01		0.02		0.02
E1509A:		0.01		0.02		0.02
E1512A:		0.01		0.02		0.02
E1513A:		0.0054		0.02		0.02

Ordering Information

Description	Product No.
8-Channel Direct Input SCP	E1501A
8-Channel 7 Hz Low-pass Filter SCP	E1502A
8-Channel Programmable Filter/Gain SCP	E1503A
8-Channel x16 Gain & 7 Hz Fixed Filter SCP	E1508A
8-Channel x64 Gain & 7 Hz Fixed Filter SCP	E1509A
8-Channel 25 Hz Fixed Filter SCP	E1512A
8-Channel ÷ 16 Fixed Attenuator & 7 Hz Low-pass Filter SCP	E1513A

Publication No.: 5988-2343EN

8-Channel Current Source SCP**Agilent E1505A**

Agilent E1505A

- Use with Agilent E1413C/E1415A/E1419A
- Eight programmable current sources
- Input over-voltage protection
- Current source for resistance and temperature measurements

Description

The Agilent Technologies E1505A 8-Channel Current Source SCP provides eight current sources programmable to one of two current levels. Each current source can be programmed to provide either 30 μ A or 488 μ A. The E1505A SCP is used to supply excitation current to resistance and resistance-temperature measurements. It also provides over-voltage protection on each channel.

Use the E1505A with the following VXI modules:

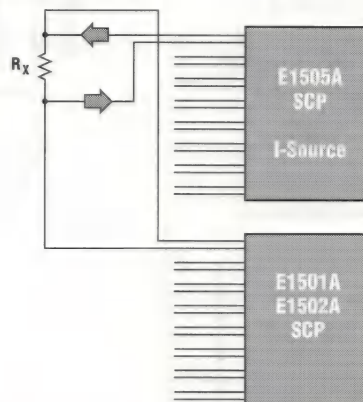
Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Resistance Measurements

Resistance is measured using the E1505A 8-Channel Current Source SCP and an input SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown resistance. The current source is provided through the E1505A.

The recommended application is as shown here using four-wire Ω connections. Two-wire Ω measurement is possible but not recommended since two 150 Ω series resistors protecting the input FET multiplexer are included in the measurement.

**Product Specifications**

These specifications for the E1505A reflect the combined performance of the scanning A/D and the E1505A SCP.

Current Source

Minimum:	30.5 μ A \pm 9 nA
Maximum:	488.3 μ A \pm 60 nA

Output Accuracy

90-day, 23° C \pm 1° C (with *CAL? done 1 hr after warm up)

Current Amplitude:

30.518 μ A:	\pm 9 nA
488.28 μ A:	\pm 60 nA

Resistance Measurements

Range Ω s FS	Current Amplitude	A/D Range (Vdc)	Maximum Resolution
131.1 k	30.518 μ A	4	4 Ω
32.77 k	30.518 μ A	1	1 Ω
8.192 k	30.518 μ A	.25	.25 Ω
8.192 k	488.28 μ A	4	.25 Ω
2.048 k	488.28 μ A	1	.0625 Ω
512	488.28 μ A	.25	.015 Ω
128	488.28 μ A	.0625	.0039 Ω

Resistance Accuracy

Any input SCP/most sensitive range. Four-wire connection.

Gain:

30.518 μ A:	\pm 0.035% of rdg
488.28 μ A:	\pm 0.02% of rdg
Offset Ω :	[offset of input SCP (in Volts)]/ [current source value (in Amps)]
Noise Ω :	[noise of input SCP (in Volts)]/ [current source value (in Amps)]

Current Requirements (Amps)

5 V max	24 V max	-24 V max
0.02	0.03	0.03

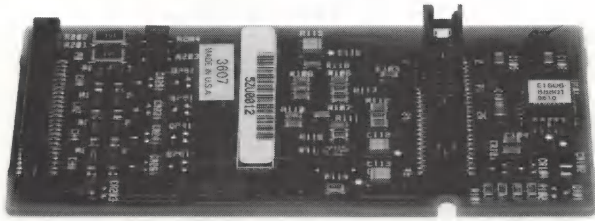
Ordering Information

Description	Product No.
8-Channel Current Source SCP	E1505A

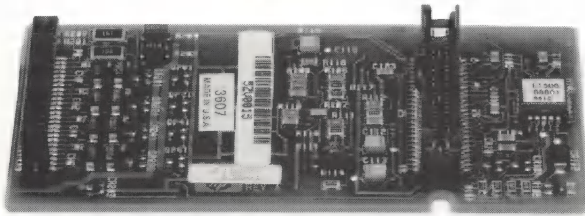
Publication No.: 5966-2387E

120 Ω and 350 Ω Strain Completion and Excitation SCPs

Agilent E1506A, E1507A



Agilent E1506A



Agilent E1507A

- Use with Agilent E1413C/E1415A/E1419A
- 120 Ω and 350 Ω strain completion and excitation
- Connections for quarter, half, and full bridges
- Requires an input SCP to make strain gage measurements

Description

The Agilent Technologies E1506A and E1507A 8-Channel Strain Completion & Excitation SCPs provide strain completion and excitation voltages for 120 Ω and 350 Ω strain bridges. Connections can be made for quarter-bridge, half-bridge, and full-bridge strain gage measurements.

Two SCPs are required to make strain gage measurements. The E1506A or E1507A SCP provides the excitation signals and bridge connections. The other SCP, the "sense" SCP, makes the measurement connections (e.g., E1501A, E1502A, E1503A, E1508A, or E1509A).

The E1506A or E1507A supplies the bridge excitation voltage for all bridge configurations. In quarter-bridge and half-bridge configurations, the E1506A or E1507A supplies the strain completion circuitry.

Use the E1506A or E1507A with the following VXI modules:

Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

Excitation Voltage

Accuracy:	3.9000 V nominal $\pm 512 \mu\text{V}$ (90 day) $23 \pm 1^\circ\text{C}$ with *CAL done after 1 hr warm-up. Measured with the E1501A Direct Input SCP.
Temp coeff:	$39 \mu\text{V}/^\circ\text{C}$
Noise (3σ):	
A/D filter off:	450 μV
A/D filter on:	366 μV

Completion Resistors

Power:	0.125 W @ 125°C
Tolerance:	0.05%
TCR:	$\pm 5 \text{ ppm}/^\circ\text{C}$

Offsets

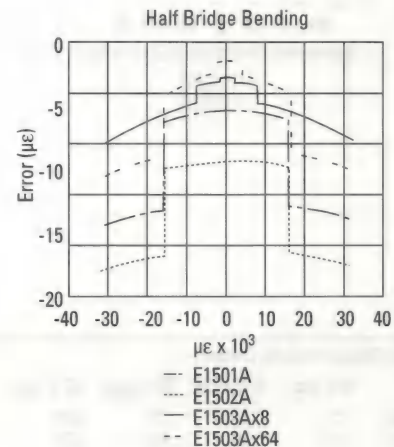
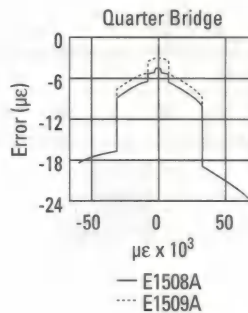
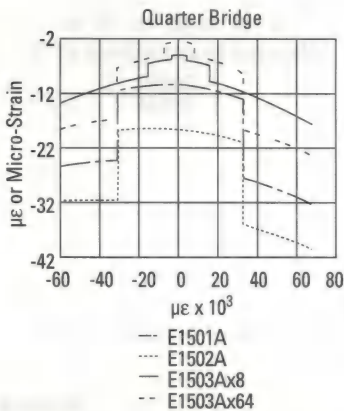
Bridge offsets:	
Quarter bridge:	$\pm 1^\circ\text{C}$ of tare cal
Offset:	$\pm 40 \mu\text{V}$

System Strain Accuracies

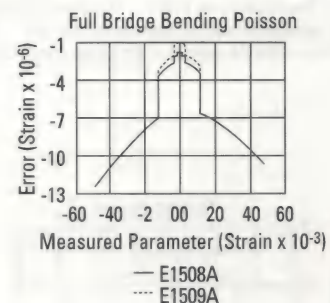
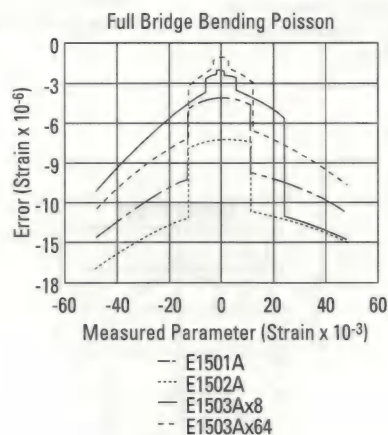
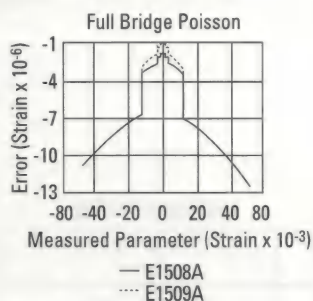
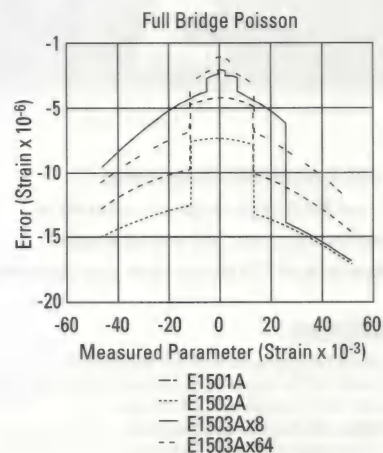
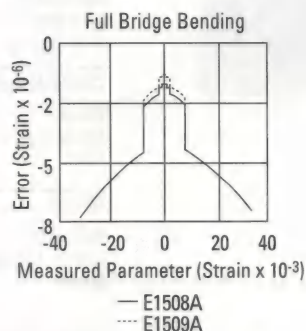
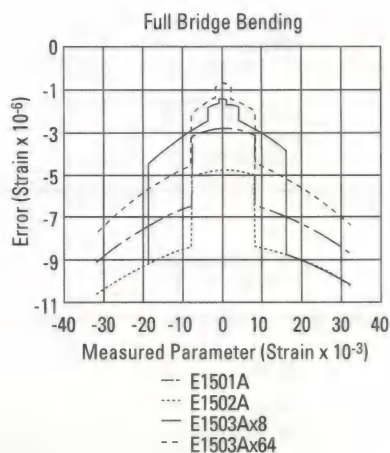
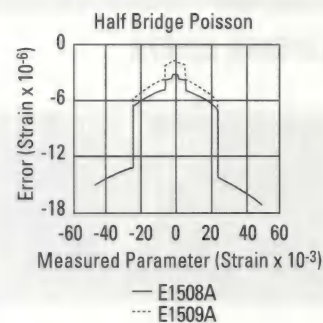
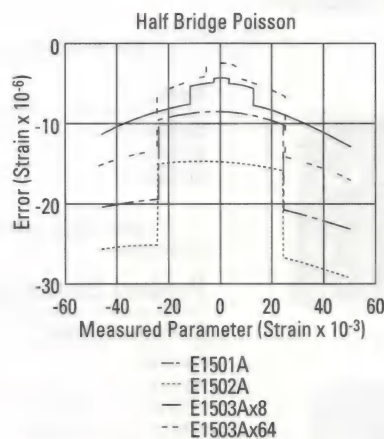
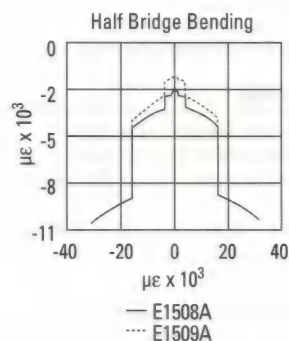
Gain + offset error:	40 $\mu\epsilon$
Noise error:	
A/D filter off:	27 $\mu\epsilon$
A/D filter on:	20 $\mu\epsilon$

Strain Measurement Accuracy

These specifications for the E1506A and E1507A reflect the combined performance of the scanning A/D plus the E1506A or E1507A for various bridge configurations.



(Agilent E1506A, E1507A continued)



Current Requirements (Amps)

	5 V typ	5 V max	24 V typ	24 V max	-24 V typ	-24 V max
E1506A:	0.28	0.28	.026	.032	.023	.027
E1507A:	0.09	0.09	.026	.032	.023	.027

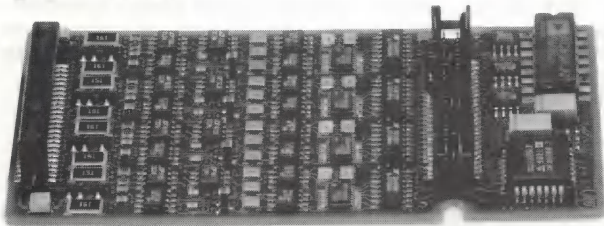
Ordering Information

Description	Product No.
8-Channel 120 Ω Strain Completion & Excitation SCP	E1506A
8-Channel 350 Ω Strain Completion & Excitation SCP	E1507A

Publication No.: 5988-2340EN

4-Channel Sample and Hold Input SCP

Agilent E1510A



Agilent E1510A

- Use with Agilent E1413C/E1415A/E1419A
- Four sample and hold channels
- Four direct input channels
- Samples all channels simultaneously, reduces skew

Description

The Agilent Technologies E1510A 4-Channel Sample and Hold SCP provides four channels of sample and hold inputs, and four channels of direct inputs for the A/Ds. The sample and hold inputs sample all four channels simultaneously to reduce the skew introduced by scanning.

The SCP circuitry provides a voltage gain of 0.5, 8, 64, or 512 for each channel.

The low-pass filter on each sample and hold channel is a 6th order Bessel active RC filter used to provide alias protection and noise reduction. The filter cutoff frequencies are 1 kHz, 500 Hz, 250 Hz, 100 Hz, and 15 Hz.

Use the E1510A with the following VXI modules:

Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

These specifications for the E1510A reflect the combined performance of the scanning A/D and the E1510A SCP.

Measurement Ranges

dc Volts: 0 V to ± 8 V Full Scale

Input Characteristics

Maximum input voltage (normal mode plus common mode):

Operating: $\leq \pm 16$ V peak
Damage level: $\geq \pm 42$ V peak

Maximum common mode voltage:

Operating: $\leq \pm 16$ V peak
Damage level: $\geq \pm 42$ V peak

Common mode rejection (0 to 60 Hz):

x0.5 gain: >60 dB
x8 gain: >78 dB
x64 gain: >100 dB
x512 gain: >100 dB
Input impedance: >100 M Ω

Maximum Tare Cal Offset

Maximum tare cal offset depends on A/D range and SCP gain.

Gain	Maximum Offset
x0.5	$\pm 25\%$ of full scale
x8	± 90 mV
x64	± 95 mV
x512	± 95 mV

Filter Characteristics (6-pole Bessel filter)

Normal mode rejection:

15 Hz filter:	
15 Hz:	-3 dB
50 Hz:	>33 dB
60 Hz:	>43 dB
100 Hz filter:	
100 Hz:	-3 dB
400 Hz:	>43 dB
250 Hz filter:	
250 Hz:	-3 dB
1000 Hz:	>43 dB
500 Hz filter:	
500 Hz:	-3 dB
2000 Hz:	>43 dB
1000 Hz filter:	
1000 Hz:	-3 dB
4000 Hz:	>43 dB

Sample Time Skew Between Channels

Because the low-pass filter precedes the sample and hold, the interchannel sample time skew is primarily determined by the matching of the filter propagation delay times. The table below lists the propagation delay for a step function input (measured at 50% of the final value) for each filter setting, as well as the matching between channels programmed to the same filter setting.

Bandwidth	Step propagation delay (nominal)	Delay matching (\pm from nominal)
1 kHz:	427.5 μ sec	10 μ sec
500 Hz:	854.9 μ sec	20 μ sec
250 Hz:	1.710 msec	40 μ sec
100 Hz:	4.275 msec	100 μ sec
15 Hz:	28.50 msec	670 μ sec

Maximum Filter Overshoot

$<1\%$ of input step size.

Measurement Accuracy dc Voltage

For autorange, add .05% of reading for input voltages $\geq \pm 4$ V.

Accuracy – Gain x0.5

Range \pm FS	Linearity % of Reading:	Offset Error:	Noise 3σ :
125 mV:	0.02	488 μ V	1.5 μ V
0.5 V:	0.02	488 μ V	1.5 μ V
2.0 V:	0.02	488 μ V	1.5 μ V
8.0 V:	0.02	488 μ V	1.5 μ V

Temperature Coefficients:

Gain: Add tempco error to above table
10 ppm/ $^{\circ}$ C (after *CAL)
Offset:
0-30 $^{\circ}$ C: 0 μ V/ $^{\circ}$ C
30-55 $^{\circ}$ C: 0.75 μ V/ $^{\circ}$ C

Accuracy – Gain x8

Range \pm FS	Linearity % of Reading:	Offset Error:	Noise 3σ :
7.8 mV:	0.02	30.5 μ V	95 μ V
31.25 mV:	0.02	30.5 μ V	95 μ V
125 mV:	0.02	30.5 μ V	95 μ V
0.5 V:	0.02	30.5 μ V	95 μ V

Temperature Coefficients:

Gain: Add tempco error to above table
10 ppm/ $^{\circ}$ C (after *CAL)
Offset:
0-30 $^{\circ}$ C: 0 μ V/ $^{\circ}$ C
30-55 $^{\circ}$ C: 0.75 μ V/ $^{\circ}$ C

(Agilent E1510A continued)

Accuracy – Gain x64

Range \pm FS	Linearity % of Reading:	Offset Error:	Noise 3 σ :
3.9 mV:	0.02	15 μ V	12 μ V
15.6 mV:	0.02	15 μ V	12 μ V
62.5 mV:	0.02	15 μ V	12 μ V

Temperature Coefficients:	Add tempco error to above table
Gain:	10 ppm/°C (after *CAL)
Offset:	
0-40 °C:	0.14 μ V/°C
40-55 °C:	0.38 μ V/°C

Accuracy – Gain x512

Range \pm FS	Linearity % of Reading:	Offset Error:	Noise 3 σ :
7.81 mV:	0.04	15 μ V	2 μ V

Temperature Coefficients:	Add tempco error to above table
Gain:	10 ppm/°C (after *CAL)
Offset:	
0-40 °C:	0.14 μ V/°C
40-55 °C:	0.38 μ V/°C

Current Requirements (Amps)

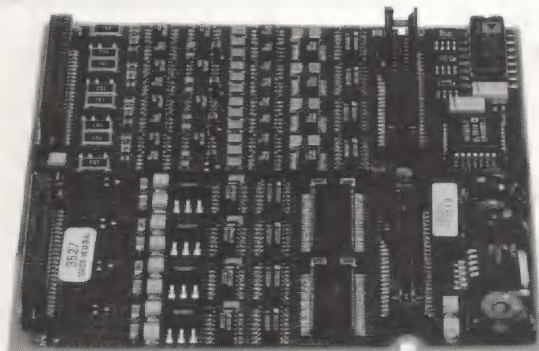
5 V max	24 V max	-24 V max
0.01	0.125	0.125

Ordering Information

Description	Product No.
4-Channel Sample & Hold Input SCP	E1510A

Publication No.: 5966-2392E

17

4-Channel Transient Strain SCP**Agilent E1511A**

Agilent E1511A

- Use with Agilent E1413C/E1415A/E1419A
- 4 channels of sample/hold strain measurements
- 4 channels of programmable excitation voltages
- Bridge excitation voltages of 1 V, 2 V, 5 V, or 10 V

Description

The Agilent Technologies E1511A 4-Channel Transient Strain SCP provides four channels of strain measurements. It provides strain completion circuitry and excitation voltages, a programmable filter, and sample and hold circuitry. The sample and hold inputs sample all four channels simultaneously to reduce the skew introduced by scanning.

The low-pass filter on each sample and hold channel is a 6th order Bessel active RC filter used to provide alias protection and noise reduction. The filter cutoff frequencies are 1 kHz, 500 Hz, 250 Hz, 100 Hz, and 15 Hz.

The SCP can be wired for measuring excitation voltages at the bridge connection (remote sense) or locally (terminal module). Excitation voltages of 0 V, 1 V, 2 V, 5 V, or 10 V are available on each channel.

The SCP provides a voltage gain of 0.5, 8, 64, or 512 for each channel. This SCP takes two adjacent slots in the VXI module.

Use the E1511A with the following VXI modules:

Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

These specifications for the E1511A reflect the combined performance of the scanning A/D and the E1511A SCP.

Measurement Ranges

dc Volts:	\pm 8 V Full Scale
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Input Characteristics**Maximum input voltage (normal mode plus common mode):**

Operating:	$< \pm$ 8 V peak
Damage level:	$> \pm$ 42 V peak

Maximum common mode voltage:

Operating:	$< \pm$ 16 V peak
Damage level:	$> \pm$ 42 V peak

Common mode rejection**(0 to 60 Hz):**

x0.5 gain:	> 60 dB
x8 gain:	> 78 dB
x64 gain:	> 100 dB
x512 gain:	> 100 dB

Input impedance:	> 100 M Ω
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Maximum Tare Cal Offset

Maximum tare cal offset depends on A/D range and SCP gain.

Gain	Maximum Offset
x0.5	\pm 25% of full scale
x8	\pm 90 mV
x64	\pm 95 mV
x512	\pm 95 mV

Filter Characteristics (6-pole Bessel filter)**Normal mode rejection:**

15 Hz filter:	
15 Hz:	-3 dB
50 Hz:	> 33 dB
60 Hz:	> 43 dB
100 Hz filter:	
100 Hz:	-3 dB
400 Hz:	> 43 dB
250 Hz filter:	
250 Hz:	-3 dB
1000 Hz:	> 43 dB
500 Hz filter:	
500 Hz:	-3 dB
2000 Hz:	> 43 dB
1000 Hz filter:	
1000 Hz:	-3 dB
4000 Hz:	> 43 dB

(Agilent E1511A continued)

Sample Time Skew Between Channels

Because the low-pass filter precedes the sample and hold, the interchannel sample time skew is primarily determined by the matching of the filter propagation delay times. The table below lists the propagation delay for a step function input (measured at 50% of the final value) for each filter setting, as well as the matching between channels programmed to the same filter setting.

Bandwidth	Step propagation delay (nominal)	Delay matching (\pm from nominal)
1 kHz:	427.5 μ sec	10 μ sec
500 Hz:	854.9 μ sec	20 μ sec
250 Hz:	1.710 μ sec	40 μ sec
100 Hz:	4.275 msec	100 μ sec
15 Hz:	28.50 msec	670 μ sec

Maximum Filter Overshoot

< 1% of input step size

Measurement Accuracy dc Voltage

For autorange, add .05% of reading for input voltages $\geq \pm 4$ V.

Accuracy — Gain x0.5

Range \pm FS	Linearity % of Offset Error: Noise 3 σ : Reading:		
125 mV:	0.02	488 μ V	1.5 μ V
0.5 mV:	0.02	488 μ V	1.5 μ V
2.0 V:	0.02	488 μ V	1.5 μ V
8.0 V:	0.02	488 μ V	1.5 μ V
Temperature Coefficients:	Add tempco error to above table		
Gain:	10 ppm/ $^{\circ}$ C (after *CAL)		
Offset:			
0-30 $^{\circ}$ C:	0 μ V/ $^{\circ}$ C		
30-55 $^{\circ}$ C:	0.75 μ V/ $^{\circ}$ C		

Accuracy — Gain x8

Range \pm FS	Linearity % of Offset Error: Noise 3 σ : Reading:		
7.8 mV:	0.02	30.5 μ V	95 μ V
31.25 mV:	0.02	30.5 μ V	95 μ V
125 mV:	0.02	30.5 μ V	95 μ V
0.5 V:	0.02	30.5 μ V	95 μ V
Temperature Coefficients:	Add tempco error to above table		
Gain:	10 ppm/ $^{\circ}$ C (after *CAL)		
Offset:			
0-30 $^{\circ}$ C:	0 μ V/ $^{\circ}$ C		
30-55 $^{\circ}$ C:	0.75 μ V/ $^{\circ}$ C		

Accuracy — Gain x64

Range \pm FS	Linearity % of Offset Error: Noise 3 σ : Reading:		
3.9 mV:	0.02	15 μ V	12 μ V
15.6 mV:	0.02	15 μ V	12 μ V
62.5 mV:	0.02	15 μ V	12 μ V
Temperature Coefficients:	Add tempco error to above table		
Gain:	10 ppm/ $^{\circ}$ C (after *CAL)		
Offset:			
0-40 $^{\circ}$ C:	0.14 μ V/ $^{\circ}$ C		
40-55 $^{\circ}$ C:	0.38 μ V/ $^{\circ}$ C		

Accuracy — Gain x512

Range \pm FS	Linearity % of Offset Error: Noise 3 σ : Reading:		
7.81 mV:	0.04	15 μ V	2 μ V
Temperature Coefficients:	Add tempco error to above table		
Gain:	10 ppm/ $^{\circ}$ C (after *CAL)		
Offset:			
0-40 $^{\circ}$ C:	0.14 μ V/ $^{\circ}$ C		
40-55 $^{\circ}$ C:	0.38 μ V/ $^{\circ}$ C		

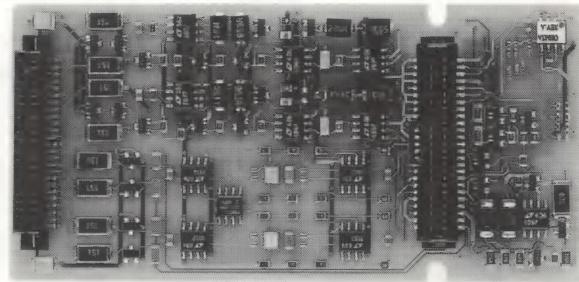
Current Requirements (Amps)

5 V max	24 V max	-24 V max
0.55	0.145	0.143

Ordering Information

Description	Product No.
4-Channel Transient Strain SCP	E1511A

Publication No.: 5966-2393E

4-Wire Resistance Measurement SCP**Agilent E1518A**

Agilent E1518A

- Four channels of 4-wire Ohms measurement
- Programmable current level on each source channel
- x16 gain and 10 Hz filter on each input channel

Description

The Agilent Technologies E1518A 4-Wire Resistance Measurement SCP provides four programmable current source channels (with input over-voltage protection) for excitation. Each current source can be programmed to provide either 30 μ A or 433 μ A.

The E1518A also has four channels of analog input with x16 gain and 10 Hz, 2-pole, low-pass filters for measuring the voltage across the resistor.

The engineering conversion to Ohms or temperature is done automatically at the full scanning rate in the base VXI module.

Use the E1518A with the following VXI modules:

Model	Description
E1413C	64-Channel Scanning A/D Converter
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

These specifications for the E1518A reflect the combined performance of the scanning A/D and the E1518A SCP.

Measurement Ranges

dc Volts:	± 3.9 mV to ± 1 V Full Scale
Temperature:	
Thermocouples:	-200 to +1700 $^{\circ}$ C
Thermistors:	-80 to +160 $^{\circ}$ C
RTD's:	-200 to +850 $^{\circ}$ C
Resistance full scale ranges (Ω):	8, 32, 128, 512, 2K, 8K, 32K

(Agilent E1518A continued)

Input Characteristics

Maximum input voltage (normal mode plus common mode):

Operating: $< \pm 16$ V peak
 Damage level: $> \pm 42$ V peak

Maximum common mode voltage:

Operating: $< \pm 16$ V peak
 Damage level: $> \pm 42$ V peak

Common mode rejection:

0 to 60 Hz: -100 dB

Input impedance: > 100 M Ω differential

Maximum Tare Cal Offset

Maximum tare cal offset depends on A/D range and SCP gain.

A/D Range \pm V F. Scale	Maximum Offset
16	0.20009
4	0.05007
1	0.01317
0.25	0.00349
0.0625	0.00112

Current Source

Minimum: $30.5 \mu\text{A} \pm 9$ nA
 Maximum: $488.3 \mu\text{A} \pm 60$ nA

Resistance Measurements

Range FS	Current Amplitude	A/D Range	Maximum Resolution
32.77 k Ω :	$30.518 \mu\text{A}$	16 Vdc	1 Ω
8.192 k Ω :	$30.518 \mu\text{A}$	4 Vdc	.25 Ω
2.048 k Ω :	$30.518 \mu\text{A}$	1 Vdc	.0625 Ω
2.048 k Ω :	$488.28 \mu\text{A}$	16 Vdc	.0625 Ω
512 Ω :	$488.28 \mu\text{A}$	4 Vdc	.0156 Ω
128 Ω :	$488.28 \mu\text{A}$	1 Vdc	.0039 Ω
32 Ω :	$488.28 \mu\text{A}$	0.25 Vdc	.0009 Ω

Resistance Accuracy

Any input SCP/Most sensitive range.
 Four-wire connections.

MIN Current Source: $\pm [0.035\%$ of rdg]
 MAX Current Source: $\pm [0.02\%$ of rdg]

Measurement Accuracy dc Volts

For autorange, add .02% of reading for input voltages $> \pm 4$ V.

Accuracy — Gain $\times 16$

Range \pm V FS	Linearity % of Reading:	Offset Error:	Noise 3 σ :	Noise* 3 σ :
0.0039:	0.01	3.8 μV	3.4 μV	2.9 μV
0.0156:	0.01	4.2 μV	4.4 μV	3.8 μV
0.0625:	0.01	4.9 μV	7.5 μV	6.3 μV
0.25:	0.01	8 μV	28 μV	23 μV
1:	0.01	31 μV	113 μV	64 μV

* A/D filter ON (min sample period $\geq 145 \mu\text{s}$; ≤ 100 Hz scan rate 64 ch).

Temperature coefficients:

Add tempco error to above table
 15 ppm/ $^{\circ}\text{C}$ (after *CAL)

Gain:

Offset:

0-30 $^{\circ}\text{C}$: 0.16 $\mu\text{V}/^{\circ}\text{C}$

30-40 $^{\circ}\text{C}$: 0.18 $\mu\text{V}/^{\circ}\text{C}$

40-55 $^{\circ}\text{C}$: 0.39 $\mu\text{V}/^{\circ}\text{C}$

Temperature Measurement Accuracy

The following temperature accuracy specifications include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS-90 transducer curves. Add your transducer accuracy to determine total measurement error.

Thermistors*

2252 Ω :

0 to 30 $^{\circ}\text{C}$: 0.006 $^{\circ}\text{C}$ 30 to 70 $^{\circ}\text{C}$: 0.013 $^{\circ}\text{C}$ 70 to 80 $^{\circ}\text{C}$: 0.010 $^{\circ}\text{C}$ 80 to 100 $^{\circ}\text{C}$: 0.014 $^{\circ}\text{C}$

5 k Ω :

0 to 30 $^{\circ}\text{C}$: 0.012 $^{\circ}\text{C}$ 30 to 70 $^{\circ}\text{C}$: 0.014 $^{\circ}\text{C}$ 70 to 85 $^{\circ}\text{C}$: 0.019 $^{\circ}\text{C}$

5 k Ω Reference:

-10 to 65 $^{\circ}\text{C}$: 0.012 $^{\circ}\text{C}$ 65 to 85 $^{\circ}\text{C}$: 0.013 $^{\circ}\text{C}$

10 k Ω :

0 to 30 $^{\circ}\text{C}$: 0.015 $^{\circ}\text{C}$ 30 to 60 $^{\circ}\text{C}$: 0.016 $^{\circ}\text{C}$ 60 to 90 $^{\circ}\text{C}$: 0.018 $^{\circ}\text{C}$ 90 to 115 $^{\circ}\text{C}$: 0.022 $^{\circ}\text{C}$

RTDs*

100 Ω :

-200 to 75 $^{\circ}\text{C}$: 0.08 $^{\circ}\text{C}$ 75 to 300 $^{\circ}\text{C}$: 0.21 $^{\circ}\text{C}$ 300 to 600 $^{\circ}\text{C}$: 0.27 $^{\circ}\text{C}$ 600 to 970 $^{\circ}\text{C}$: 0.37 $^{\circ}\text{C}$

100 Ω Reference:

-125 to 70 $^{\circ}\text{C}$: 0.145 $^{\circ}\text{C}$

*A/D filter OFF.

Current Requirements (Amps)

5 V max	24 V max	-24 V max
0.01	0.033	0.039

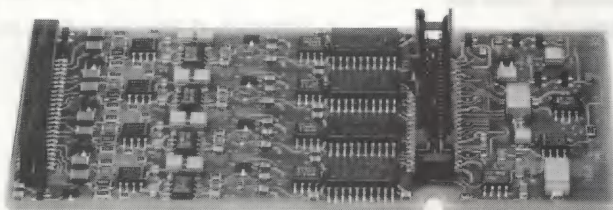
Ordering Information

Description	Product No.
4-Wire Resistance Measurement SCP	E1518A

Publication No.: 5966-2400E

8-Channel Voltage Output SCP

Agilent E1531A



Agilent E1531A

- 8-channel non-isolated voltage source
- Current limited to protect from short circuits
- Source ± 16 V at up to 5 mA output current

(Agilent E1531A continued)

Description

The Agilent Technologies E1531A 8-Channel Voltage Output SCP provides eight channels of non-isolated voltage source outputs. Each channel can source ± 16 V at up to 5 mA output current. The output voltage resolution is 16 bits (500 μ V). Each output is current-limited to protect it from short circuits.

Use the E1531A with the following VXI modules:

Model	Description
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

Maximum Input Voltage

(Non-operating externally applied voltage without damage applied to any output Hi terminal)

Damage level: $> \pm 42$ V peak

Noise

20 Hz to 250 kHz: < 1.2 mV rms

Voltage Output

Range: ± 16 V (Full Scale at up to 5 mA)
 Resolution: 16 bits = 500 μ V (monotonic to 16 bits)
 Accuracy: * ($\pm 0.02\%$ of expected output) $\pm (3.6$ mV offset error)

Temperature coefficient:

Accuracy: $\pm 0.004\%/^{\circ}\text{C}$
 Offset error: 0.2 mV/ $^{\circ}\text{C}$
 Settling time: 300 μ s
 Output impedance: 50 Ω , 15 Ω through Common Mode Choke

* 23 $^{\circ}$ C $\pm 1^{\circ}$ C (90 days)

Power Required

± 5 V:
 Typical: 11 mA
 Maximum: 15 mA
 ± 24 V:
 0 mA output typical: 60 mA
 0 mA output maximum: 75 mA
 5 mA output typical: 100 mA
 5 mA output maximum: 115 mA

Current Requirements (Amps)

5 V max	24 V max	-24 V max
0.015	0.075	0.075

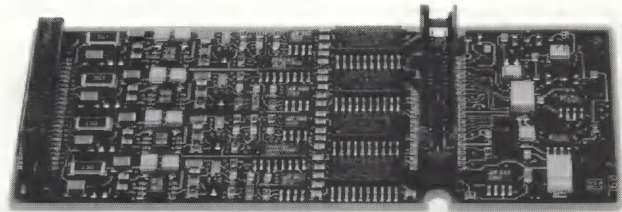
Ordering Information

Description	Product No.
8-Channel Voltage Output SCP	E1531A

Publication No.: 5966-2401E

8-Channel Current Output SCP

Agilent E1532A



Agilent E1532A

- 8-channel non-isolated current source
- Over-voltage protection
- Source ± 10 mA with up to 15 V compliance

Description

The Agilent Technologies E1532A 8-Channel Current Output SCP provides eight channels of non-isolated current source outputs. Each output can source ± 10 mA with up to 15 V compliance.

Each channel has over-voltage protection to protect the SCP and A/D from damaging voltage levels (> 21 V) applied to its outputs. You can connect two channels in parallel to use with 4-20 mA control loops. Power limitations will allow only seven (7) E1532A SCPs to be installed in an E1415A or E1419A.

Use the E1532A with the following VXI modules:

Model	Description
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

Maximum Input Voltage

(Non-operating externally applied voltage without damage applied to any output Hi terminal)

Damage level: $> \pm 42$ V peak

Noise

20 Hz to 250 kHz,
 into 250 Ω : < 2 μ A rms

Current Output

Range: ± 10 mA (Full Scale at $\geq \pm 15$ V compliance)
 Resolution: 16 bits = 316 nA (monotonic to 16 bits)
 Accuracy: * ($\pm 0.06\%$ of expected output) $\pm (3.3$ μ A offset error)

Temperature coefficient:

Accuracy: $\pm 0.004\%/^{\circ}\text{C}$
 Offset error: 0.3 μ A/ $^{\circ}\text{C}$
 Settling time: 350 μ s with 250 Ω load
 Output impedance: $> \pm 600$ k Ω

* 23 $^{\circ}$ C $\pm 1^{\circ}$ C (90 days)

Power Required

± 5 V:
 Typical: 11 mA
 Maximum: 15 mA
 ± 24 V:
 0 mA output typical: 60 mA
 0 mA output maximum: 75 mA
 10 mA output typical: 135 mA
 10 mA output maximum: 150 mA

Current Requirements (Amps)

5 V max	24 V max	-24 V max
0.011	0.065	0.065

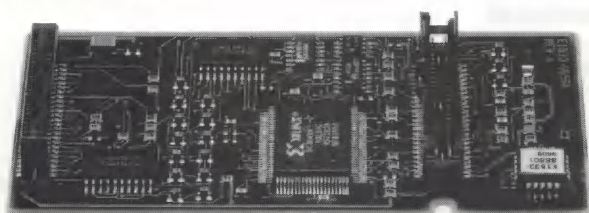
(Agilent E1532A continued)

Ordering Information

Description	Product No.
8-Channel Current Output SCP	E1532A
Publication No.: 5966-2414E	

16-Bit Digital I/O SCP

Agilent E1533A



Agilent E1533A

- 16 non-isolated TTL inputs/outputs
- Arranged in two 8-bit ports (channels)
- Active or passive pull-up for output channels

Description

The Agilent Technologies E1533A 16-Bit Digital I/O SCP provides 16 TTL compatible input/output lines. The 16 TTL bits are grouped as two, 8-bit "channels". Each channel can be configured as an 8-bit input port, or an 8-bit output port. When configured for output, each channel can be either passive (resistor) pull-up or active (transistor) pull-up.

Each output terminal is provided with over-voltage protection to prevent damage to the SCP or A/D module. Voltages greater than 6 V on any terminal will generate an error.

Use the E1533A with the following VXI modules:

Model	Description
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Product Specifications

Output Characteristics

Current source (logic 1):

Active pull-up:	5 mA
Passive pull-up:	0 mA

Current sink (logic 0):

Active pull-up:	48 mA
Passive pull-up:	48 mA

Voltage (logic 1):

Active pull-up:	2.5 V min. @ 5 mA load
Passive pull-up:	n/a

Voltage (logic 0):

Active pull-up:	0.5 V max. @ 48 mA load
Passive pull-up:	0.5 V max. @ 48 mA load

Input Characteristics

Equivalent circuit:	1.2 K Ω connected to 3 V
Maximum input low:	0.8 V
Minimum input low:	2 V
Maximum voltage:	+5.5 V and -0.5 V (inputs clamped, user must limit current to 15 mA)

Current Requirements (Amps)

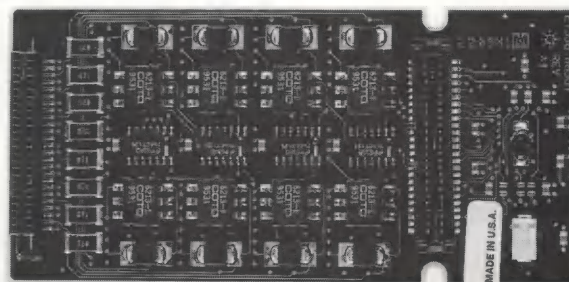
5 V max	24 V max	-24 V max
0.08	0.015	0.006

Ordering Information

Description	Product No.
16-Bit Digital I/O SCP	E1533A
Publication No.: 5966-2402E	

8-Bit Isolated Digital I/O SCP

Agilent E1536A



Agilent E1536A

- Use with Agilent E1415A and E1419A
- 8 TTL input/output lines isolated to 56 Vdc
- Programmable threshold levels of 5 V, 12 V, 24 V, or 48 V
- Programmable debounce timer

Description

The Agilent Technologies E1536A 8-Bit Isolated Digital I/O SCP provides eight bits (channels) with individually programmable threshold levels of 5 V, 12 V, 24 V, or 48 V. Channels are clamped at about 60 V by a "crowbar" protection circuit.

Each channel can be configured as an input port or an output port. Both inputs/outputs have programmable polarity.

The outputs are optically isolated solid state ac/dc Form A relay outputs with a 10 Ω on resistance and 200 mA carrying current capability. The inputs are optically isolated with programmable threshold levels and debounce.

Use the E1536A with the following VXI modules:

Model	Description
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

(Agilent E1536A continued)

Product Specifications

Output Characteristics

Maximum continuous voltage:	56 Vdc (39 Vrms)
Peak current load:	200 mA
Relay on resistance:	10 Ω
Turn on/turn off time:	3 ms
Clamping voltage:	60 V

Input Characteristics

Maximum continuous voltage:	56 Vdc (39 Vrms)
Maximum input zero:	
5 V threshold:	1.4 V
12 V threshold:	2 V
24 V threshold:	3 V
48 V threshold:	5 V
Minimum input one:	
5 V threshold:	2.1 V
12 V threshold:	7 V
24 V threshold:	13 V
48 V threshold:	25 V
Input debounce time:	150 μ s — 2.4 s in binary increments

Current Requirements (Amps)

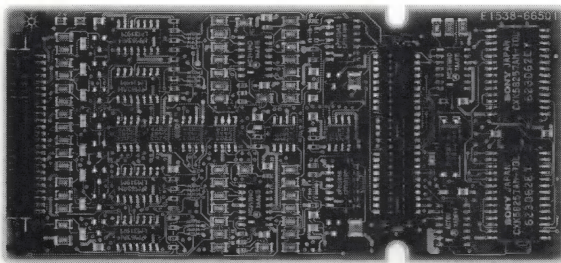
5 V max	24 V max	-24 V max
0.072	0	0

Ordering Information

Description	Product No.
8-Bit Isolated Digital I/O SCP	E1536A
Publication No.: 5966-2407E	

Enhanced Frequency/Totalize/PWM SCP

Agilent E1538A



Agilent E1538A

- 8-channel, non-isolated, variable input level
- Frequency counter input to 100 kHz
- Totalize to >16 million counts
- PWM output — square wave or variable pulse width
- Pulse width measurement
- Quadrature count and stepper motor control

Description

The Agilent Technologies E1538A Enhanced Frequency/Totalize/PWM SCP has eight channels. Each of the eight channels can be individually configured to perform input or output functions. Input functions include frequency measurement and totalize, pulse width measurement, rpm, and quadrature count. Output functions can free run or can be triggered. Output functions include square waves, pulse trains, angular position pulse, and stepper motor control.

Any channel can be configured as a one-bit variable level digital input or output. Additionally, two channels may be configured for low-level sensors.

Use the E1538A with the following VXI modules:

Model	Description
E1415A	Algorithmic Closed Loop Controller
E1419A	Multifunction Measurement and Control Module

Refer to the Agilent Technologies Website for recent product updates, if applicable.

Wide Range of Input/Output Functionality

The E1538A channels can be individually configured to either an input or an output function.

Input functions include:

- static digital state
- frequency measurement
- totalize positive or negative digital transitions
- pulse width measurement
- rotational velocity (senses added or missing cogwheel teeth)
- quadrature count (two channels required)

Output functions include:

- static digital state
- single pulse per trigger
- pulse width modulation
- frequency modulation
- rotationally position pulse
- stepper motor control

The logical sense of input and output channels can be configured as inverted or normal. Input channels have individual threshold levels up to ± 48 V. Output channels can be configured as either open drain or passive pull-up.

Input Functions

Digital Input: Each channel has a programmable threshold comparator. The digital input threshold can be programmatically set from -48 V to $+47$ V. The digital input polarity may also be changed.

Low Level Sensors: The first two channels provide variable level inputs compatible with magnetic pickup sensors or variable reluctance sensors, like turbine flowmeters, that provide signals within the level and frequency ranges specified below. These channels are configured with adaptive amplifiers to sense the wide range of sensor output voltages. The E1538A can directly sense voltage from 100 mV to 10 V. Voltages up to 120 V can be sensed using an external resistor.

Totalize, Frequency and Period: Totalize on either positive or negative transitions. Measure frequency with a programmable aperture time. Measure logical 1 pulse widths from 1.5 μ s to 1 s.

Quadrature Count: Use two channels to make 24-bit quadrature counts. One channel provides the count, the second channel controls the count direction (up or down). Counts from 0 to 16,777,215.

Rotational Velocity: One E1538A input channel can be used to sense rotational velocity using a toothed wheel sensor. The tooth-to-tooth periods are measured and converted into revolutions-per-second (RPS). Use this function with sensors that have either a missing or extra tooth to mark their index position.

(Agilent E1538A continued)

Output Functions

Digital Output: Each E1538A output "open-drain" MOSFET can switch from 0 to 48 V and sink up to 100 mA. An internal pull-up resistor is provided for driving logic devices directly. Output logical polarity is programmable.

Pulse Output: Each E1538A channel can be programmed to output a variety of pulses and pulse trains. Variable width, PWM, FM and rotationally positioned pulse outputs are available.

Stepper Motor Control: The E1538A can control 2- or 4-phase motors in either full- or half-step mode. The SCP can directly drive four-phase stepper motors requiring <100 mA phase current. Higher phase current requirements are possible using external output amplifier circuits.

Product Specifications

Output Characteristics

Current source (logic 1):

Pull-up off:	0 mA
Pull-up on:	380 mA @ 1.2 V

Current sink (logic 0):

Pull-up off:	100 mA
Pull-up on:	100 mA

Voltage (logic 1):

Pull-up off:	0 V
Pull-up on:	5 V (no load)

Voltage (logic 0):

Pull-up off:	0.1 V max. @ 100 mA load
	0.05 max. @ 20 mA load
Pull-up on:	0.1 V max. @ 100 mA
	0.5 max. @ 20 mA load

Input Characteristics

Equivalent circuit:

Pull-up off:	120 k Ω connected to 0 V
Pull-up on:	9.2 k Ω connected to 4.6 V

Maximum input low:

Pull-up off:	-46 V to 46 V prog.
Pull-up on:	-46 V to 46 V prog.

Minimum input high:

Pull-up off:	-46 V to 46 V prog.
Pull-up on:	-46 V to 46 V prog.

Maximum voltage:

Applied to input terminal:	-48 V to 48 V
Applied to output terminal:	0 V to 48 V (diode clamped at -0.3 V)

Totalizer

Capacity:	24 bits or 16,777,215 counts
Minimum pulse width:	500 ns
Frequency range:	0-100 kHz

Frequency Counter

Gate time (t_{aperture}):	1 ms to 1 s, resolution $1/f_{\text{in}}$
Range:	$1/t_{\text{aperture}}$ to 100 kHz
Accuracy:	0.01%
Resolution:	$f_{\text{in}}/(t_{\text{aperture}} \times 4.194 \text{ MHz})$
Min. pulse width:	500 ns

Rotational Velocity Measure

Range in RPS:	$1/n_{\text{teeth}}$ to $100,000/n_{\text{teeth}}$
Accuracy:	0.01%
Resolution in RPS:	$(n_{\text{teeth}} \times f)^2 / 4.194 \text{ MHz}$
Minimum pulse width:	500 ns

Pulse Width Measure

Periods averaged:	1 to 255
Range:	1.5 μs to 1 S
Accuracy:	$\pm(100 \text{ ns} + 0.1\%)$
Resolution:	59.6 nsec

Frequency Source

Range:	
Square wave:	64 Hz to 40 kHz
Other shapes:	128 Hz to 40 kHz
Accuracy:	0.01%
Resolution:	$(f_{\text{out}})^2 / 4.194 \text{ MHz}$

Pulse Source

Range:	
Pulse width:	7.87 μs to $1/f \cdot 7.87 \mu\text{s}$
Pulse per trig:	7.87 μs to 7.812 ms
Accuracy:	200 ns + 0.01%
Resolution:	238.4 ns

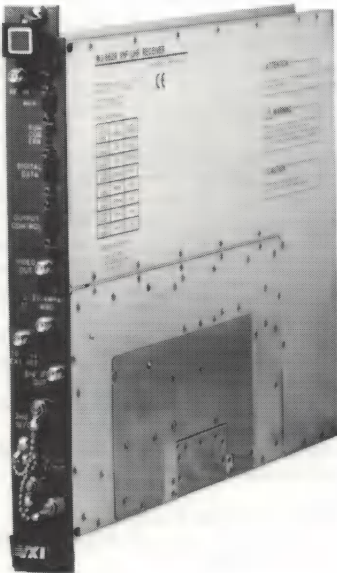
Current Requirements (Amps)

5 V max	24 V max	-24 V max
0.2	0.054	0.025

Ordering Information

Description	Product No.
Enhanced Frequency/Totalize/PWM SCP	E1538A
Publication No.: 5966-2409E	

WJ-8629A

**C-Size Modules**

Product No.	Description
VXI-AIC	ARINC 429/561/573/575/708/717 Interface (Referenced Product)
CS-5040VXI	Microwave Tuner (Referenced Product)
WJ-8621	VXI VHF/UHF Wideband ViXIceptor (Referenced Product)
WJ-8629A	Software Definable VXI VHF/UHF Receiver (Referenced Product)
WJ-8634	VXI VHF/UHF Receiver (Referenced Product)
WJ-8721	VXI High-Frequency Digital Receiver (Referenced Product)

Introduction

The VXI modules in this section are offered by hardware vendors not affiliated with Agilent Technologies, but are useful in a variety of applications, including avionics and radio/television signal processing. Some are used in conjunction with Agilent Technologies VXI products in data acquisition and signal analysis systems. You must contact each individual hardware vendor to order or obtain more information about these products.

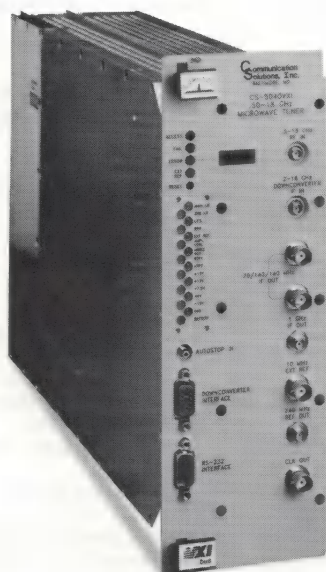
Condor Engineering's VXI-AIC ARINC Interface is a solution that provides a single integrated interface to multiple avionics protocols for test, simulation and maintenance applications.

Communication Solutions' CS-5040VXI Microwave Tuner provides the frequency extension to cover the microwave range (up to 20 GHz) in the Agilent E3238 Signals Development System (see the Signal Analysis Systems product section). It operates well in both signal acquisition and monitoring applications where FDM, PCM and radar signals are present.

BAE Systems' WJ-8621 VXI VHF/UHF Wideband ViXIceptor is a general purpose receiver that covers the 20 MHz to 2.7 GHz frequency range. The WJ-8629A Software Definable VXI VHF/UHF Receiver covers the same frequency, using digital signal processing (DSP) technology. The WJ-8634 VXI VHF/UHF Receiver has an extended UHF range of 20 MHz to 2.4 GHz and HF range of .5 to 1000 MHz. The WJ-8721 VXI High-frequency Digital Receiver is for monitoring and direction-finding from 5 kHz to 30 MHz, with 1 Hz resolution.

VXI Microwave Tuner

CS-5040VXI (Referenced Product)



CS-5040VXI Microwave Tuner

- Frequency range: 0.1 - 22 GHz; 0.5 - 18 GHz standard
- High dynamic range and low phase noise
- Selectable narrowband and wideband IF outputs
- Instantaneous 500 MHz IF bandwidth
- Excellent search engine
- Supports Agilent E3238 Signals Development system

Description

The CS-5040VXI Microwave Tuner is a C-size, 3-slot each, message-based VXI Microwave Tuner manufactured and distributed by Communication Solutions, Inc. The unit is controlled through the VXI standard control bus using either a message- or register-based interface. The CS-5040VXI tuner provides the frequency extension to cover the microwave range, up to 20 GHz, in the Agilent E3238 Signals Development system.

The CS-5040VXI is a fully synthesized downconverter operating from 0.5 to 18 GHz (standard), with very fine 100 Hz tuning resolution and excellent 0.5°rms (typical) phase noise performance. It operates well in both signal acquisition and monitoring applications, where FDM, PCM, and radar signals are present. Very low group delay and high dynamic range performance contribute to making the CS-5040VXI an excellent swept or set-on tuner in dense signal environments.

The various IF outputs that can be provided include: 1 GHz/500 MHz bandwidth, 70/50 MHz BW, 140/85 MHz BW, and/or 160/85 MHz BW. The standard IF configuration is a 1.0 GHz/500 MHz IF output, with other IF outputs optional.

This product is referenced by Agilent Technologies. It is manufactured and sold by Communication Solutions, Inc., of Baltimore, MD. Agilent does not sell, distribute, warrant, or support this product.

For more information contact:
Communication Solutions, Inc.
Baltimore, MD U.S.A.
Telephone: 410-344-9000
Fax: 410-344-1790
www.comsol-inc.com

The CS-5040VXI uses an internal, low phase noise crystal reference as the standard for each LO within the tuner. The internal reference automatically locks to an external 10 MHz reference, when applied.

The CS-5040VXI front panel contains signal inputs, outputs, and monitor points, several unit status indicators, and an auxiliary RS-232 control interface. The front panel has a 4-digit LED status display, which presents codes based upon condition of the tuner and automatically updates on a routine basis. All parameters can be controlled through the VXI interface and can be monitored via the interface, including BITE. RS-232 control interface is available via a 9-pin "D" connector. This is an auxiliary port to facilitate troubleshooting efforts.

External block downconverters provide frequency extension in the following bands: 18-40 GHz, 40-60 GHz, with higher bands available. The CS-5040VXI supplies the reference and power to the downconverters via RF and control/power cables. The small, modular design allows the block downconverters to be mounted close to the antenna in order to reduce signal loss and alleviate difficult waveguide runs. Options per band include, 1) a pre-amplifier to improve system noise figure, and 2) an 18 dB gain horn antenna.

The tuner's 3-slot VXI standard package derives power from the mainframe and relies on forced air from the VXI frame for cooling. The unit is designed to meet the requirements of MIL-STD-461D, RE-02 and CE-03, and includes mechanical shielding techniques such as EMI gasketing and waveguide beyond cutoff hole patterns for cooling. The unit blind mates into the rack as any VXI package and has external interface connectors on the front panel of the instrument. The digital and power interfaces are mounted in the standard configuration and communication with other adjacent slot devices is through the rear panel bus.

Related Instruments: CS-5040-XX Millimeter-wave Extenders; CS-5045VXI IF Demodulator; CS-5047VXI Display Digitizer; CS-1097/1098VXI IF to Baseband/Tape Converters; CS-824VXI Multicoupler.

Product Specifications

Frequency range:	0.5 - 18 GHz (standard)
Input signal level:	+20 dBm max.
LO re-radiation:	-95 dBm max.
Noise figure:	13 dB typical
Input Third Order Intercept (TOI) point:	0 dBm typical
Image rejection:	70 dB min.
Tuning resolution:	100 Hz
Frequency stability:	5×10^{-9} /day after warm-up
Full band settling time:	10 ms max. (after last command bit)
Tuning modes:	CW & Sweep
Internally generated spurious:	-80 dBm max. @ output
Phase noise:	0.5°rms typical
IF output frequency:	1 GHz/500 MHz standard 70/140/160 MHz (Option 1b)
RF / IF gain:	20 dB min.
Group delay (70 MHz IF output):	5 ns max. over any 40 MHz segment
Input VSWR:	2.5:1 max., 50 ohms
Power consumption:	80 watts max.
BITE:	Power supply voltages, internal temperature, phase lock status, phase lock tuning voltages

General Specifications

VXI Characteristics

VXI device type:	Message based and register based
Size:	C
Slots:	3
Connectors:	
Power/control:	P1/P2 (2 sets)
RF input:	SMA female or "K"
IF output:	BNC female (70, 140 & 160 MHz) SM female (1.0 GHz)

(CS-5040VXI continued)

Module Current		
Supply (Vdc)	Current (amps) actual	Current (amps) surge
+24	.766	1.24
+12	1.26	1.28
+5	.680	.736
-5.2	.24	.250
-12	.316	.426
-24	1.15	1.52

Ordering Information

Description	Product No.
Microwave Tuner	CS-5040VXI
70/140 & 160 MHz IF Output Selectable	Option 1b, 1c
Log Amplifier	Option 2a, 2b
0.1 - 22 GHz Coverage	Option 4a, b or c
Frequency Extender Interface	Option 4d
AGC/MGC Control	Option 5
RF Input Blanking/Attenuator	Option 6a, 6b
Display Interface	Option 7
COMINT/ELINT Filters	Option 8a, 8b
Operations Manual	TM0142-02
Std. 1-year Warranty	

Order from:

Communication Solutions, Inc.
10552 Philadelphia Road
White Marsh, MD 21162
Telephone: 410-344-9000
Fax: 410-344-1790

<http://www.comsol-inc.com>

Note: This product cannot be ordered from Agilent Technologies.

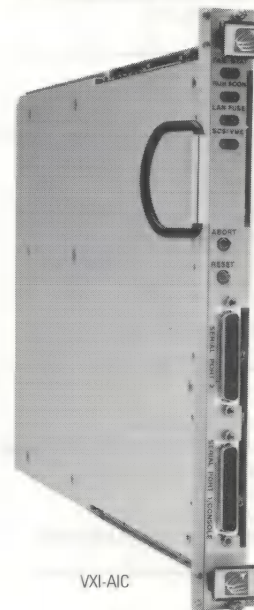
Referenced Product

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Publication No.: Not Available

ARINC 429/561/573/575/708/717
Interface

VXI-AIC (Referenced Product)



- Up to 64 ARINC channels per VXI board
- Supports multiple avionics protocols including MIL-STD-1553
- Flexible on-board message scheduling
- 4 or 16 Mbytes memory storage
- Multiple data buffering mechanisms
- Ideal for automated test applications

Description

The C-size, 1-slot, register-based VXI-AIC is an intelligent, high-performance solution that provides a single integrated interface to multiple avionics protocols for test, simulation and maintenance applications. By combining powerful 68x040/060 processing with Condor software and data bus technology, up to 64 ARINC 429 channels (32 Rx/32 Tx), or a mix of avionics protocols is available on a single board.

Configuration options include MIL-STD-1553, ARINC 419, 429, 561, 568, 571, 573, 575, 582, 585, 708, 717, CSDB and RS-232/422/423/485. Windows NT/98/95, LabVIEW, Linux, LabWindows/CVI and Visual Basic support across a PCI-MXI-2 is available.

ARINC bit rate, filtering, parity, error injection, receiver thresholds, output voltages and timetags are software selectable. Multiple data buffering mechanisms (filtered, merged, snapshot) are provided. Up to 5,000 frames of received data per channel can be stored, and up to 8,192 unique messages may be automatically scheduled. Message data and update rates may be modified at any time.

This product is referenced by Agilent Technologies. It is manufactured and sold by Condor Engineering, Inc. Agilent does not sell, distribute, warrant, or support this product.

For more information contact:

Condor Engineering, Inc.
Santa Barbara, CA, U.S.A
Telephone 805-965-8000
www.condoreng.com

(VXI-AIC continued)

Product Specifications

Processor	
Standard:	Motorola 25 MHz MC68LC040
Optional:	64 MHz MC68LC060

Memory	
DRAM:	4 or 16 MB

ARINC 429 / 575 Receive Channels

Receive channels:	From 1 to 32
Bit rates:	11 KHz, 12K-14.5 KHz or 100 KHz (software selectable) Up to 5,000 frames per channel
Buffer:	Yes
Error detection:	Yes
Parity:	Odd, even or none
Parametrics:	Variable threshold level (optional)

ARINC 429 / 575 Transmit Channels

Transmit channels:	From 1 to 32 dedicated
Bit rates:	11 KHz/12.5 KHz or 100 KHz (software selectable); 50 KHz available
Error injection:	Yes
Parity:	Odd, even or none
Parametrics:	Variable output voltage (optional)

ARINC 561 / 568 6-Wire Channels

Channels:	From 1 to 4 pairs of Rx and Tx
Bit rate:	11 KHz
Word size:	32 bits
Parity:	none

ARINC 573 / 717 Channels

Channels:	From 1 to 4 pairs of Rx and Tx
Phase:	HBP or BPRZ
Bit rate:	768 to 24,576 bps
Subframe size:	64 to 512 words
Word size:	12 bits

ARINC 708 Channels

Channels:	From 1 to 4 Rx/Tx channels
Buffers:	92 Rx frames, 148 Tx frames (per channel)
Bit rate:	1 MHz

CSDB Channels

Channels:	From 2 to 16 pairs of Rx and Tx
Buffers:	256 Rx frames, 512 Tx frames per channel
Bit rate:	12.5 or 50 KHz, programmable to 100 KHz
Parametrics:	Rx thresholds, Tx voltages

RS-232, RS-422, RS-423, RS-485 Ports

Ports:	Up to 16
Bit rate:	Selectable to 38.4 Kbps
UART:	Philips SCC 2698B

General Specifications

VXI Characteristics

VXI device type:	Register based
Data transfer bus:	A32/24; D32/16 Slave
Size:	C
Slots:	1
Connectors:	P1/P2
Data connections:	50-pin flat ribbon cables
Shared memory:	3 MB

Memory	
DRAM:	4 or 16 MB

Other VXI Characteristics

Functional in VME environment:	Yes
User definable VME/VXI interrupts:	Level and vector
Built-in test:	Internal wraparound self-test and full test of dual ported RAM

Module Current

	I _{PM}	I _{DM}
+5 V:	3.2 A	3.2 A
+12 V:	150 mA	250 mA
-12 V:	150 mA	250 mA
+24 V:		
-24 V:		
-5.2 V:		
-2 V:		

Ordering Information

Condor Engineering Product No.	Description	Product No.
VXI-AIC-xxxx-yy	Avionics Interface Controller for VXIbus	VXI-AIC

Order from:

Condor Engineering, Inc.
101 W. Anapamu Street
Santa Barbara, CA 93101
Phone: 805-965-8000
Fax: 805-963-9630
www.condoreng.com and info@condoreng.com

Note: This product cannot be ordered from Agilent Technologies.

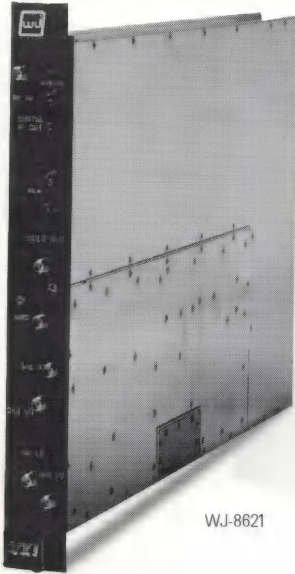
Referenced Product

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Publication No.: Not available

VXI VHF/UHF Wideband ViXlceptor

WJ-8621 (Referenced Product)



WJ-8621

- 1-Slot, C-size, message based
- +10 dBm third-order intercept point, typical
- 12 dB noise figure, typical
- 12.5 MHz wideband IF output
- Front panel-mounted RS-232 auxiliary control port
- Powerful built-in search capabilities

Description

The WJ-8621 is a general-purpose VHF/UHF receiver covering the 20 to 2700 MHz frequency range. The WJ-8621 is ideal for applications requiring broad-frequency coverage in a highly integrated package.

The WJ-8621 receiver features low-phase-noise frequency synthesizers, a preselector equipped front end, 100 Hz tuning resolution, and high dynamic range. The WJ-8621 uses traditional analog circuitry to achieve wideband signal processing capability. The high-performance sub-octave preselector filters incoming RF signals, and rejects undesired out-of-band signals, improving the usability of the receiver in dense signal environments.

A high-speed message-based VXI interface provides remote control. This interface provides accessibility to all functions except power. An operator may also control the WJ-8621 from its auxiliary RS-232 port on the receiver front panel.

Internal switching allows the WJ-8621 to route a sample of the local oscillators (LOs) to another receiver, or to apply external LOs to the unit. An operator can cable together a pair of WJ-8621 receivers to form a two-channel phase-coherent system. Systems needing more than two channels require an external LO divider/buffer module.

This product is referenced by Agilent Technologies. It is manufactured and sold by BAE SYSTEMS. Agilent does not sell, distribute, warrant, or support this product.

For more information contact:
BAE SYSTEMS
Gaithersburg, MD, U.S.A.
Telephone: 800-954-3577 or 301-948-7550
www.signalsurveillance.com

Ordering Information

Description	Product No.
VXI VHF/UHF Wideband ViXlceptor	WJ-8621

Order from:

BAE SYSTEMS
700 Quince Orchard Road,
Gaithersburg, MD 20878-1794
Telephone: 800-WJHELPS (954-3577) or 301-948-7550
www.signalsurveillance.com

Note: This product cannot be ordered from Agilent Technologies.

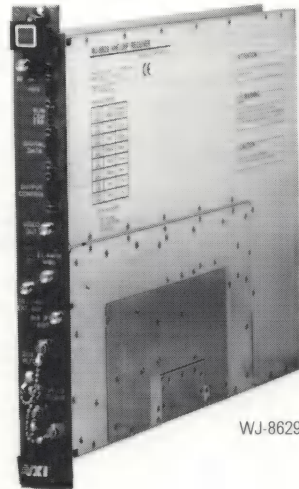
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Publication No.: Not available

Software Definable VXI VHF/UHF Receiver

WJ-8629A (Referenced Product)



WJ-8629A

- +10 dBm third-order intercept point, typical
- Switchable RF pre-amp
- 22 IF filters from 200 Hz to 1.23 MHz
- Digital data available in either D16 or D32 VXI formats
- 12.5-MHz wideband IF output
- Software Developer's Kit for creating DSP algorithms

Description

The WJ-8629A is a software definable, 20 to 2700 MHz, VHF/UHF receiver. The WJ-8629A is ideal for applications requiring both digital signal data and broad-frequency coverage in a highly integrated package. Combining receiver control and digital signal data directly on a standard instrumentation and computing bus adds significant system capabilities, while reducing the complexity of system integration.

(WJ-8629A continued)

The WJ-8629A receiver features DSP, low-phase-noise frequency synthesizers, a preselected front end, 10-Hz tuning resolution, and high dynamic range. The use of digital IF and demodulator signal processing provides the WJ-8629A with highly stable and repeatable IF filter characteristics. The high-performance sub-octave preselector filters incoming RF signals, and rejects undesired out-of-band signals. The WJ-8629A receiver is unsurpassed in its ability to reject adjacent channel interference. The receiver uses digital IF filters in conjunction with very low phase noise synthesizers to accomplish high rejection of adjacent channel interference. This is an extremely important performance parameter when operating in a dense signal environment.

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For more information contact:
BAE SYSTEMS
Gaithersburg, MD, U.S.A.
Telephone: 800-954-3577 or 301-948-7550
www.signalsurveillance.com

Ordering Information

Description	Product No.
Software Definable VXI VHF/UHF Receiver	WJ-8629A

Order from:
BAE SYSTEMS
700 Quince Orchard Road,
Gaithersburg, MD 20878-1794
Telephone: 800-WJHELPS (954-3577) or 301-948-7550
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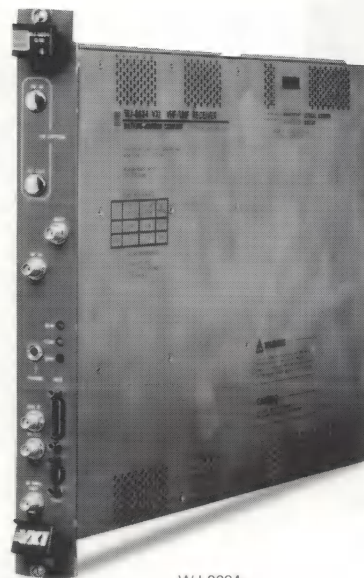
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Publication No.: Not available

VXI VHF/UHF Receiver

WJ-8634 (Referenced Product)



WJ-8634

- 1-Slot, C-size, message based
- UHF extended frequency range 20 to 2400 MHz
- HF extended frequency range 0.5 to 1000 MHz
- Narrowband configuration supports 4 IFBW's between 6.4 and 100 kHz. AM, FM, SSB, CW & IFT detection modes
- Wideband configuration supports 4 IFBW's between 300 kHz and 12 MHz. AM & FM detection modes
- Tracking preselector filter

Description

The WJ-8634 is a fully synthesized, general purpose VHF/UHF receiver for surveillance and monitoring of RF communications. The unit is packaged in a **single-slot C-size VXI module**. The WJ-8634 features low phase noise frequency synthesizers with 100-Hz tuning resolution, in a low-power VXI package. A high-performance tracking preselector filters incoming RF signals, and rejects undesired out-of-band signals. In the SWEEP or STEP mode of operation, the receiver is capable of logging the COR status of signals in the coverage area and only reporting changes to the controlling device. In the SWEEP mode, bands or signals may be locked out of the coverage area. Non-volatile memory in the receiver stores up to 200 sweep or step setups, and up to 200 lockout bands.

In the Standard or UHF Extended configuration, tuning down to 2 MHz is allowed.

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Gaithersburg, MD, U.S.A.
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www.signalsurveillance.com

Ordering Information

Description	Product No.
VXI VHF/UHF Receiver	WJ-8634

(WJ-8634 continued)**Order from:**

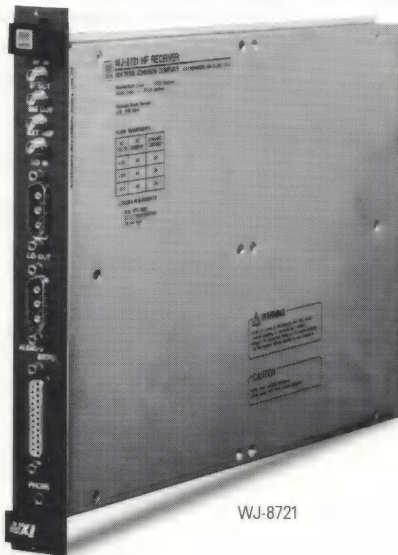
BAE SYSTEMS
700 Quince Orchard Road,
Gaithersburg, MD 20878-1794
Telephone: 800-WJHELPS (954-3577) or 301-948-7550
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Publication No.: Not available

VXI HF Digital Receiver**WJ-8721 (Referenced Product)**

WJ-8721

- 1-Slot, C-size, message based
- Master/slave phase-locked LO's
- In-phase and quadrature digital outputs standard
- Digital IF data available on VXIbus
- 66 digital IF bandwidths

Description

The WJ-8721 receiver is a fully synthesized, general purpose **HF receiver for surveillance, monitoring and direction finding** for RF communications from 5 kHz to 30 MHz with 1 Hz tuning resolution. It is ideal for applications requiring high density and the highest degree of integration. Placing the receiver directly on a standard instrumentation and computing bus significantly reduces difficulties in system integration.

Functions such as noise blanking, tunable notch filter, IF filtering, automatic gain control (AGC), demodulation, and beat frequency oscillator (BFO) tuning are accomplished through the use of digital signal processing (DSP) techniques. Filters with superior amplitude and group delay characteristics are achieved with digital stability and repeatability. 66 selectable bandwidths range from 56 Hz to 16 kHz. Available detection modes are AM, FM, CW, USB, LSB, and LBS. A tunable BFO is adjustable in 10 Hz steps over a ± 8000 Hz range. Passband tuning further enhances the reception of available AGC modes. The squelch threshold is adjustable from 0 to -135 dBm, or can be disabled.

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For more information contact:

BAE SYSTEMS
Gaithersburg, MD, U.S.A.
Telephone: 800-954-3577 or 301-948-7550
www.signalsurveillance.com

Ordering Information

Description	Product No.
VXI HF Digital Receiver	WJ-8721

Order from:

BAE SYSTEMS
700 Quince Orchard Road,
Gaithersburg, MD 20878-1794
Telephone: 800-WJHELPS (954-3577) or 301-948-7550
www.signalsurveillance.com

Note: This product cannot be ordered from Agilent Technologies.

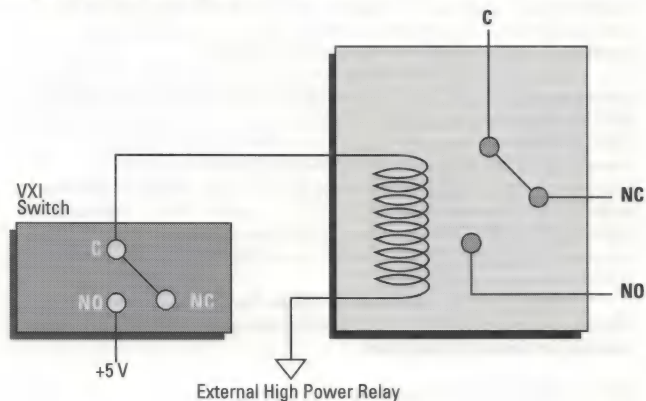
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Publication No.: Not available

Overview

General Purpose Switch Diagram



B-Size General Purpose Switch

Product No.	Description
E1364A	16-Channel Form C Switch

C-Size General Purpose Switches

Product No.	Description
E8480A	40-Channel, High-Power, GP Switch
E1442A	64-Channel Form C or Form A Switch
E1463A	32-Channel, 5 Amp, Form C Switch

Introduction

A general purpose switch module provides individual switches for controlling devices and routing general purpose signals. The Family Specifications table in this section provides comparative information for each of the Agilent Technologies VXIbus General Purpose Switches.

Overview: General Purpose Switch Choices

Agilent Technologies offers four general purpose switches for your test system needs. The E8480A is capable of carrying 12 amps of current on a single channel for power-switching applications. The E1364A and E1463A modules are both Form C switches, 1 amp and 5 amp respectively. Both are versatile switch modules with latching armature relays. The E1463A is capable of carrying 5 amps of current on a single channel, making it suitable for power-switching applications. Plus, its low thermal offset voltage makes it suitable for signal switching and scanning applications.

Agilent also offers the E1442A nonlatching Form C (SPDT) general purpose switch. Optional signal conditioning and Form A configuration is also available. This switch can be used for device actuation, as digital output, or to create flexible signal switching topologies.

Switches, General Purpose

Family Specifications

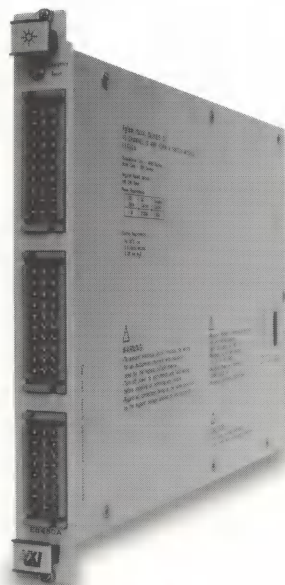
Model	E1364A	E1442A	E1463A	E8480A
	16-Channel	64-Channel	32-Channel	40-Channel
Form:	C (SPDT)	C (SPDT) or A (SPST)	C (SPDT)	A (SPST)
Input				
Max. voltage dc:	250 V	150 V	125 V	150 V
Max. voltage ac rms:	250 V	150 V	250 V	280 V
Max. voltage ac peak:	354 V	210 V	—	—
Maximum current (noninductive, per switch):				
dc:	1 A	1 A	5 A ⁽¹⁾	12 A @ 30 Vdc
ac rms:	1 A	1 A	5 A ⁽¹⁾	12 A
Maximum Power:				
dc (per switch):	40 W	40 W	150 W	360 W
ac (per switch):	40 VA	40 VA	1,250 VA	3,360 VA
dc				
Maximum thermal offset:	<7 μ V	70 μ V	7 μ V (<3 μ V typ)	10 μ V
Initial closed channel resistance:	<1.5 Ω typ	<1.5 Ω typ	.030 Ω @ 1 A & 6 V dc	100 m Ω typical
Insulation resistance (between any two points):				
$\leq 40^\circ$ C, $\leq 95\%$ RH:	—	—	>10E8 Ω	—
$\leq 40^\circ$ C, $\leq 65\%$ RH:	>10E7 Ω	>10E7 Ω	—	>10E8 Ω
$\leq 25^\circ$ C, $\leq 40\%$ RH:	>10E8 Ω	>10E8 Ω	>10E9 Ω	>10E9 Ω
ac				
Typical bandwidth (-3 dB):	10 MHz	10 MHz	10 MHz	10 MHz
Crosstalk (dB, channel-to-channel):				
<10 kHz:	—	—	<-83	<-65 dB
<100 kHz:	<-80	<-70	<-63	<-45 dB
<1 MHz:	—	—	<-43	—
<10 MHz:	<-30	<-28	—	—
Closed channel capacitance:				
Channel-to-channel:	<20 pF	30 pF	<30 pF	<200 pF
Channel-to-com:	<20 pF	<40 pF	<40 pF	—
Time to close or open a channel ⁽²⁾ :	10.7 ms	13 ms	16 ms	15 ms
VXI Characteristics				
Size:	B	C	C	C
Slots:	1	1	1	1
VXI device type:	Register based	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.				
VXI plug&play Win Framework:	Yes	Yes	Yes	No
VXI plug&play Win 95/NT Framework:	Yes	Yes	Yes	Yes
VXI plug&play HP-UX Framework:	No	No	No	No

⁽¹⁾ 50 Adc or ac rms per module.

⁽²⁾ Register programming.

40-Channel, High-Power, General Purpose Switch

Agilent E8480A



Agilent E8480A

- 1-Slot, C-size, register based
- Ideal for switching ac or dc power
- Up to 12 amps per channel
- Non-latching relays
- Normally open terminals

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Description

The Agilent Technologies E8480A 40-Channel, High-Power, General Purpose Switch is a C-size, 1-slot, register-based VXI module. It is capable of switching up to 12 amps of current on a single channel for power-switching applications. These applications include process control, appliance pass/fail testing, environmental testing and on/off control, among many others.

There are two 30-pin male connectors and one 24-pin male connector on the front panel of the E8480A. The E8480A Option 105 provides two 30-pin mating female connectors, and Option 106 provides one 24-pin mating female connector. Both options include the female connector(s) and crimp contacts which are inserted into the connector bodies. The crimp contacts support up to 12 AWG (4.0 sq. mm) wire.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Number of Channels:	40
Form:	A (SPST)

Input

Maximum voltage:	
dc:	150 V
ac rms:	280 V
Maximum transient impulse:	
Vpk:	2,500 V
Maximum current (noninductive, per switch):	
dc:	12 A @ 30 V 3.5 A @ 40 V 0.3 A @ 150 V
ac:	12 A
Maximum power:	
dc (per switch):	360 W
ac (per switch):	3,360 VA
dc (per module):	2,160 W
ac (per module):	20,160 VA

dc

Maximum thermal offset:	10 μ V
Initial closed channel resistance:	100 m Ω typical
Insulation resistance (between any two points):	
$\leq 40^\circ$ C, $\leq 95\%$ RH:	n/a
$\leq 40^\circ$ C, $\leq 65\%$ RH:	$> 10E8 \Omega$
$\leq 25^\circ$ C, $\leq 40\%$ RH:	$> 10E9 \Omega$

ac

Typical bandwidth (-3 dB):	10 MHz
Crosstalk (dB, channel-to-channel):	
< 10 kHz:	< -65 dB
< 100 KHz:	< -45 dB
< 1 MHz:	n/a
< 10 MHz:	n/a
Closed-channel capacitance:	
Hi to Lo (channel open):	< 200 pF
Ch-to-ch:	< 200 pF
Ch-to-chassis:	< 200 pF

General

Typical relay life (number of operations):	
No load:	10E7
At rated load*:	10E5
Time to close or open a channel:	15 ms

*Note: Minimum load 5 Vdc, 0.1 A per channel

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, Slave only
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.11.01
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

Watts/slot:	86
ΔP mm H₂O:	0.70
Air flow liter/s:	6.9

(Agilent E8480A continued)

Module Current

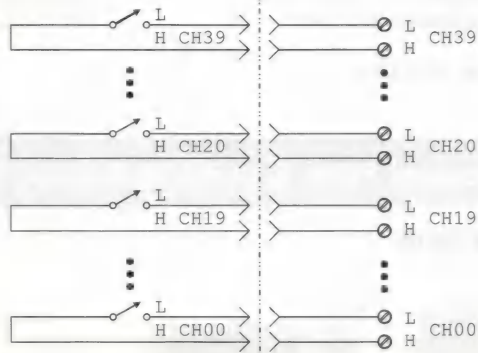
	I_{PM} (A)	I_{DM} (A)
+5 V:	3.5	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Ordering Information

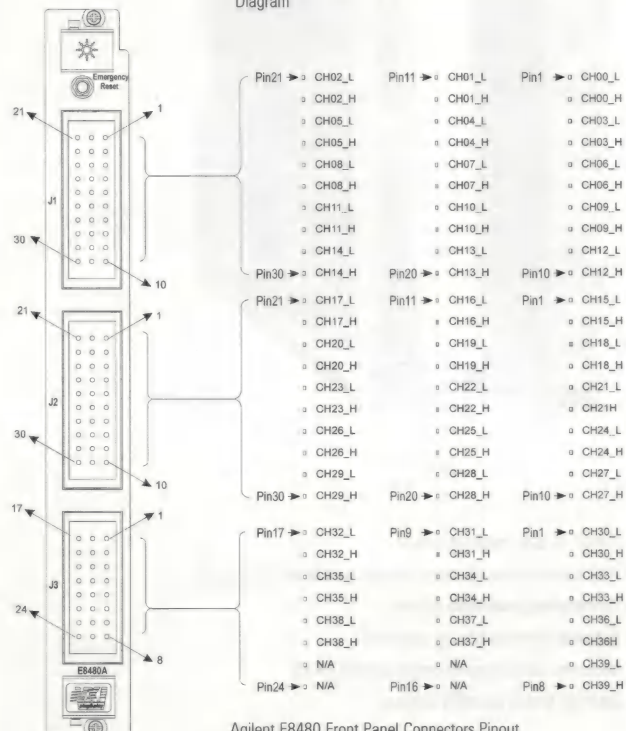
Description	Product No.
40-Channel, High-Power, General Purpose Switch	E8480A
Two 30-pin Female Mating Connectors	E8480A 105
One 24-pin Female Mating Connector	E8480A 106
3 yr. Retn. to Agilent to 1 yr. OnSite warr.	E8480A W01

E8480A Switch Module

To Connectors (J1-3)



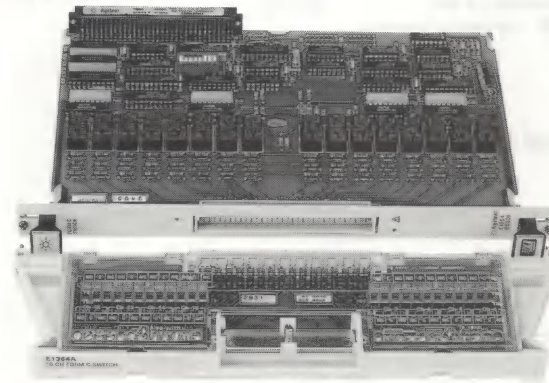
Agilent E8480A Circuit Diagram



Agilent E8480 Front Panel Connectors Pinout

16-Channel Form C Switch

Agilent E1364A



Agilent E1364A

- 1-Slot, B-size, register based
- High dc isolation for switching/measurement integrity
- Digital output of 5 V/12 V for actuating external devices
- 250 V, 1 A dc or ac signal latching relays
- Normally closed/open, and common terminals (SPDT)
- Simultaneous channel switching

Description

The Agilent Technologies E1364A 16-Channel Form C Switch is a **B-size, 1-slot, register-based VXI module**. It uses latching armature relays, and is capable of carrying 1 Amp of current on a single channel. This versatile general-purpose switch is suitable for switching, scanning, control, or digital output applications.

This module contains positions for jumpers or resistors, allowing each channel to optionally connect to internal +5 V or +12 V supplies for digital output applications. Current on these supplies should not exceed 1 A and 0.5 A, respectively, per switch. The latching relays ensure all switches will remain in the same position when power is removed. A terminal block is also included.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Maximum voltage (C to NC or NO or any terminal-to-chassis):

dc:	250 V
ac rms:	250 V
ac peak:	354 V

Maximum current (noninductive, per switch):

dc:	1 A
ac rms:	1 A

Maximum power per switch:

dc:	40 W
ac:	40 VA

Maximum power per module:

dc:	320 W
ac:	320 VA

dc

Maximum thermal offset: 7 μ V

Closed channel resistance:

Initial: <1.5 Ω typ

End of life: <3.5 Ω

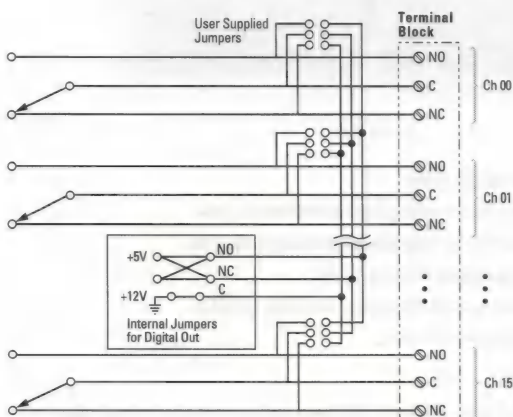
Insulation resistance (between any two points):

$\leq 40^\circ\text{C}$, $\leq 65\%$ RH:	n/a
$\leq 40^\circ\text{C}$, $\leq 95\%$ RH:	>10E7 Ω
$\leq 25^\circ\text{C}$, $\leq 40\%$ RH:	>10E8 Ω

(Agilent E1364A continued)

ac

Typical bandwidth (–3 dB):	10 MHz
Crosstalk (dB, channel-to-channel):	
<10 kHz:	n/a
<100 kHz:	<–80
<1 MHz:	n/a
<10 MHz:	<–30
Closed channel capacitance:	
Ch-to-ch:	<20 pF
Ch-to-com:	<20 pF



Agilent E1364A Circuit Diagram

General

Typical relay life (number of operations):

No load:	>10E6
Rated load:	>10E5
Time to close or open a channel (register programming):	10.7 ms

Power-down state:	Relay states are unchanged
Power-up state:	Relays open
Connector type, wire size:	Screw ≥ 16 AWG (1.5 mm)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.24	0.01
–12 V:	0	0
+24 V:	0	0
–24 V:	0	0
–5.2 V:	0	0
–2 V:	0	0

Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air flow liter/s:	0.10

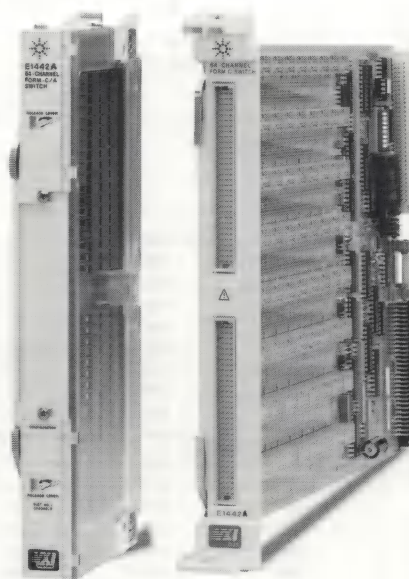
Ordering Information

Description	Product No.
16-Channel Form C Switch	E1364A
Service Manual	E1364A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1364A W01
Extra Terminal Block for the E1364A	E1364-80001

Publication No.: 5965-5587E

64-Channel Form C or Form A Switch

Agilent E1442A



Agilent E1442A

- 1-Slot, C-size, register based
- Any combination of channels can be closed or opened
- Nonlatching armature relays
- External devices can be actuated
- Includes QUIC easy-to-use terminal block
- Internal buses simplify wiring

(Agilent E1442A continued)

Description

The Agilent Technologies E1442A 64-Channel General-Purpose Switch is a C-size, 1-slot, register-based VXI module that contains nonlatching Form C type relays. They can be used for device actuation, as digital output modules, or to create flexible signal switching topologies.

Each product has two parts—a component card containing the relays, that plugs into the mainframe, and a removable terminal block that plugs onto the component card. The component card has 64 Form C relays with three independent axial component locations per relay. These locations can be used for jumpers, fuses, or pullup/down and protection resistors. All three relay terminals can be connected through such components to one of three internal buses.

The E1442A terminal block comes standard with solder lugs that allow full access to the Form C (SPDT) capability of the component module relays. Option 020 has a screw terminal block that allows access to the Form A (SPST) contacts only. Option 010 gives you complete Form C connectivity with more customization versatility.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Maximum voltage (C to NC or NO or any terminal-to-chassis):

dc:	150 V
ac rms:	150 V
ac peak:	210 V

Maximum current (noninductive, per switch):

dc:	1 A
ac rms:	1 A

Maximum power per switch:

dc:	40 W
ac:	40 VA

Maximum power per module:

dc:	320 W
ac:	320 VA

dc

Maximum thermal offset: 70 μ V

Closed channel resistance:

Initial:	<1.5 Ω typical
End of life:	<3.5 Ω

Insulation resistance (between any two points):

$\leq 40^\circ\text{C}$, $\leq 65\%$ RH:	n/a
$\leq 40^\circ\text{C}$, $\leq 95\%$ RH:	>10E7 Ω
$\leq 25^\circ\text{C}$, $\leq 40\%$ RH:	>10E8 Ω

ac

Typical bandwidth (–3 dB): 10 MHz

Crosstalk (dB, channel-to-channel):

<10 kHz:	n/a
<100 kHz:	<–70
<1 MHz:	n/a
<10 MHz:	<–28

Closed channel capacitance:

Ch-to-ch:	<30 pF
Ch-to-com:	<40 pF

General

Typical relay life (number of operations):

No load:	>5x10E6
Rated load:	>10E5

Time to close or open a channel (register programming): 13 ms

Connector type, wire size:

Standard:	2 DIN-Cs with solder lugs Opt 010: solder eyes
Screw:	≥ 18 AWG (1.2 mm), Opt 020

Power up/down states: All open, i.e., nonlatching

Terminal Block

Connection types:

Standard:	Solder lug connectors
E1442A with Opt 010:	Replaces standard terminal block with provision to add dual 96-pin DIN-C connectors or solder wires directly to terminal block pc board, 0.055 moh holes, 20 AWG max. recommended.
E1442A with Opt 020:	Replaces standard terminal block with screw terminals for com and no contacts only, 16 AWG (1.5 mm) max.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website

(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable

Command module firmware rev: A.06

I-SCPI Win 3.1: Yes

I-SCPI Series 700: Yes

C-SCPI LynxOS: Yes

C-SCPI Series 700: Yes

Panel Drivers: Yes

VXIplug&play Win Framework: Yes

VXIplug&play Win 95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

Module Current

	I_{PM}	I_{PM}
+5 V:	0.1	0.11
+12 V:	0	0
–12 V:	0	0
+24 V:	0	0
–24 V:	0	0
–5.2 V:	0	0
–2 V:	0	0

Cooling/Slot

Watts/slot:	5.00
ΔP mm H ₂ O:	0.15
Air flow liter/s:	0.42

(Agilent E1442A continued)

Ordering Information

Description	Product No.
64-Channel Form C or Form A Switch	E1442A
Form C Switch, QUIC interface, solder terminal block with pull-up/pull-down resistor dividers	E1442A 010
Form A Switch, QUIC interface, screw terminal block	E1442A 020
Same as standard E1442A except replaces QUIC interface with "old style" terminal block and front panel	E1442A 106
Same as E1442A Option 010 except replaces QUIC interface with "old style" terminal block and front panel	E1442A 116
Same as E1442A Option 020 except replaces QUIC interface with "old style" terminal block and front panel	E1442A 126
Service Manual	E1442A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1442A W01

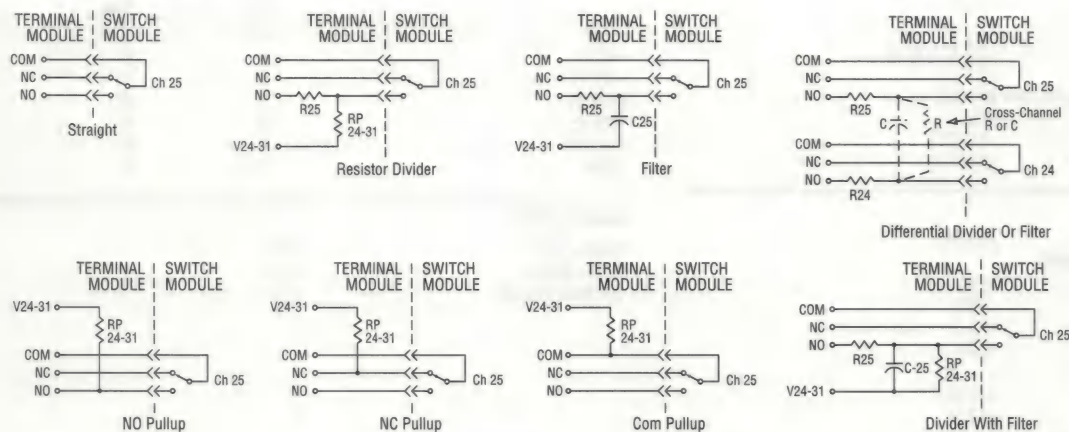
Ordering Instructions

If you want...

- a Form C switch, QUIC interface and solder terminal block, please order the E1442A.
- a Form C switch, QUIC interface and solder terminal block with pull up/pull down resistive divider, order the E1442A with Option 010.
- a Form A switch, QUIC interface and screw terminal block, order the E1442A with Option 020.

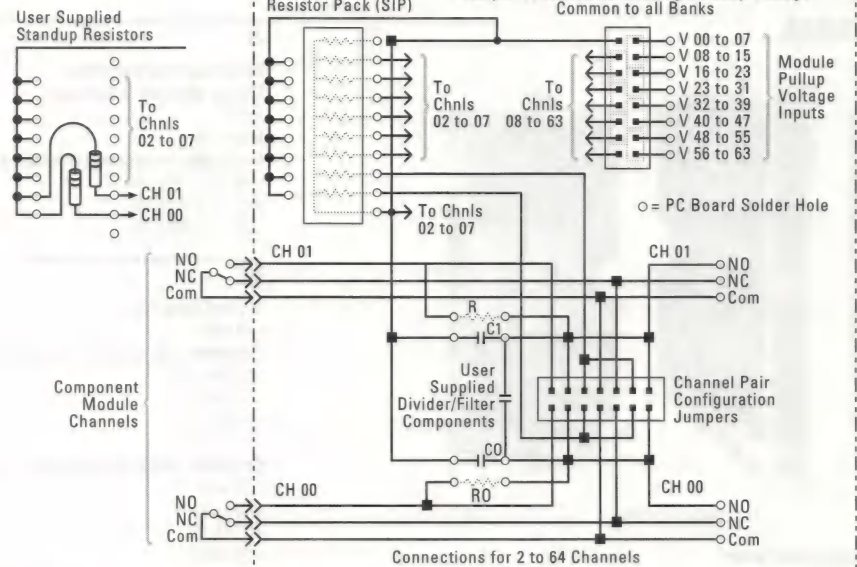
Note:

- The E1442A Option 106 is the same as the standard E1442A, but with the "old style" terminal block & front panel.
- The E1442A Option 116 is the same as the E1442A Opt. 010, but with the "old style" terminal block & front panel.
- The E1442A Option 126 is the same as the E1442A Option 020, but with the "old style" terminal block & front panel.
- There is not an option to order pull up/pull down resistive dividers with the Form A option, and there is not an option to order Form C with screw terminal block.



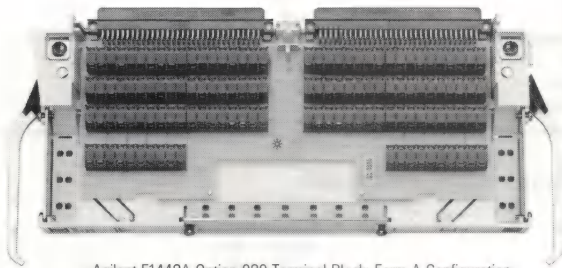
Option 010 Connection Examples

(Agilent E1442A continued)

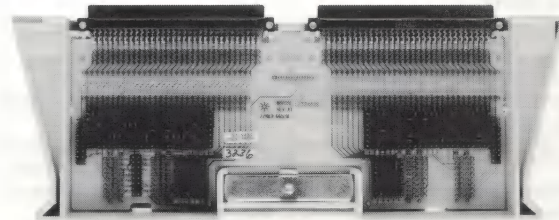
**E1442A Option 010
Circuit Diagram**

Note: User Supplied Pullup resistors can be either
a) Discrete Standup or b) Resistor Pack

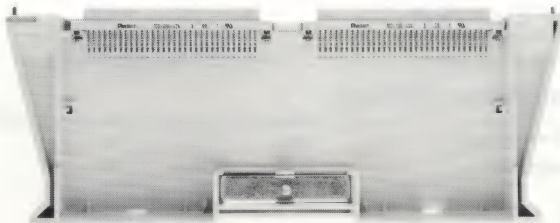
Agilent E1442A Option 010 Block Diagram



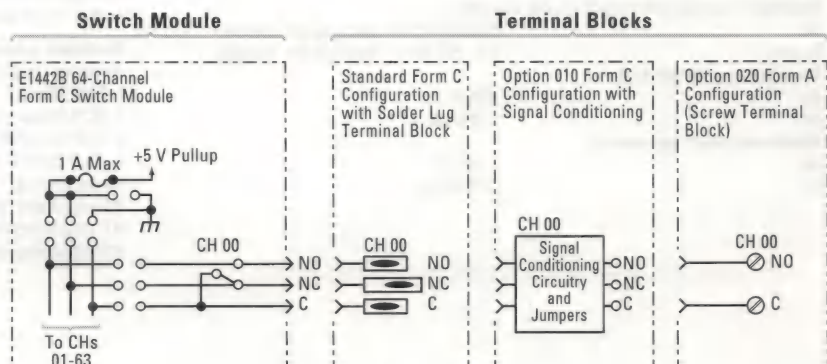
Agilent E1442A Option 020 Terminal Block: Form A Configuration with screw terminals and QUIC interface.



Agilent E1442A Option 116 Terminal Block: Form C Configuration with solder terminal block with pull up/pull down resistors and "old style" interface.



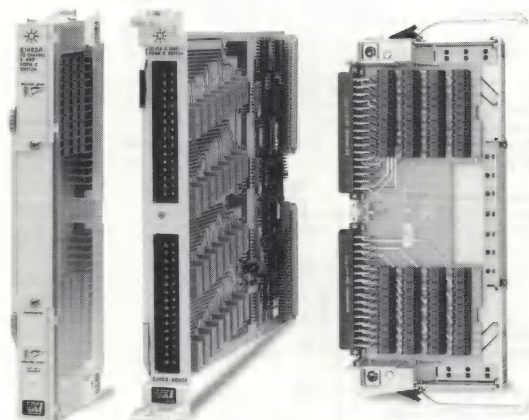
Agilent E1442A Option 106 Terminal Block: Form C Configuration with solder lugs and "old style" interface.

E1442A Block Diagram

Agilent E1442A Block Diagram

32-Channel, 5 Amp, Form C VXI Switch

Agilent E1463A



Agilent E1463A

- 1-Slot, C-size, register based
- Nonlatching relays
- Normally closed/open and common terminals (SPDT)
- Space for adding varistors for greater relay protection
- QUIC easy-to-use terminal block included
- Generates low thermal offset voltage (<3 μ V typical)

Description

The Agilent Technologies E1463A 32-Channel Form C Switch is a C-size, 1-slot, register-based VXI module. It is capable of carrying 5 Amps of current on a single channel for power-switching applications. These applications include process control, appliance pass/fail testing, and on/off control among many others.

This general-purpose switch generates low thermal offset voltage (<3 μ V typical), making it suitable for signal switching and scanning applications. The E1463A comes with the QUIC screw terminal block (optional solder eye connectors) for easy wiring. Space to add series and shunt signal conditioning or circuit-protection elements – MOVs and fuses – is available on the main board but not on the terminal block. Extra screw terminal blocks can be purchased and wired separately if multiple applications share the E1463A.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Maximum voltage (C to NC or NO or any terminal-to-chassis):

dc: 125 V
(250 V non-switched)

ac rms: 250 V

ac peak: n/a

Maximum current (noninductive, per switch):

dc: 5 A, (50 Adc or Aac rms per module)

ac rms: 5 A, (50 Adc or Aac rms per module)

Maximum power per switch:

dc: 150 W

ac: 1,250 VA

Maximum power per module:

dc: 1,500 W

ac: 12,500 VA

dc

Maximum thermal offset: 7 μ V (<3 μ V typ)

Closed channel resistance:

Initial: .030 Ω @ 1 A & 6 V dc

End of life: <2.0 Ω

Insulation resistance (between any two points):

$\leq 40^\circ\text{C}$, $\leq 65\%$ RH: >10E8 Ω

$\leq 40^\circ\text{C}$, $\leq 95\%$ RH: n/a

$\leq 25^\circ\text{C}$, $\leq 40\%$ RH: >10E9 Ω

ac

Typical bandwidth 10 MHz

(-3 dB):

Crosstalk (dB, channel-to-channel):

<10 kHz: <-83

<100 kHz: <-63

<1 MHz: <-43

<10 MHz: —

Crosstalk (dB, common-to-NO or NC):

<10 kHz: <-80

<100 kHz: <-60

<1 MHz: <-40

<10 MHz: n/a

Crosstalk (dB, module-to-module):

<10 kHz: <-100

<100 kHz: <-100

<1 MHz: <-90

<10 MHz: n/a

Closed channel capacitance:

Ch-to-ch: <30 pF

Ch-to-com: <40 pF

Ch-to-guard: <25 pF

General

Typical relay life (number of operations):

No load: >5 x 10E7

Rated load: >3.5 x 10E4 (250 Vac, 5 A, power factor = 0.4)

>10E5 (250 Vac, 5 A resistive)

>10E5 (30 Vdc, 5 A L/R = 7 ms)

Time to close or open a channel

(register programming):

16 ms

Connector type, wire size:

Screw, ≥ 18 AWG (1.2 mm)

Power up/down states:

Normally open contact is open

General Specifications

VXI Characteristics

VXI device type: Register based, A16, slave only

Size: C

Slots: 1

Connectors: P1/2

Shared memory: None

VXI buses: None

Instrument Drivers - See the Agilent Technologies Website

(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable

Command module firmware rev: A.08

I-SCPI Win 3.1: Yes

I-SCPI Series 700: Yes

C-SCPI LynxOS: Yes

C-SCPI Series 700: Yes

Panel Drivers: Yes

VXIplug&play Win Framework: Yes

VXIplug&play Win 95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

(Agilent E1463A continued)

Module Current

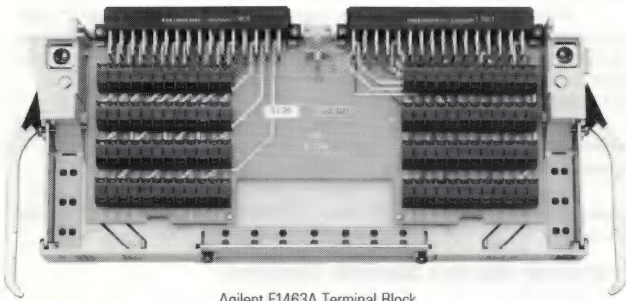
	I_{PM}	I_{DM}
+5 V:	0.1	0.1
+12 V:	0.6	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

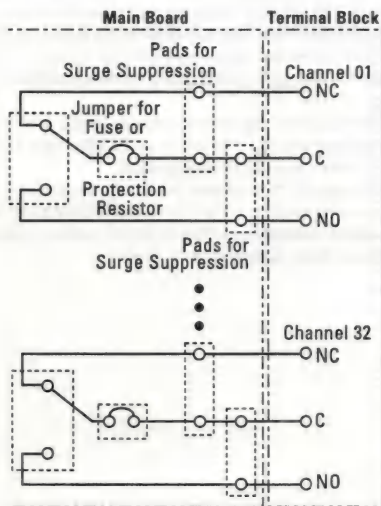
Watts/slot:	10.00
ΔP mm H ₂ O:	0.08
Air flow liter/s:	0.42

Ordering Information

Description	Product No.
32-Channel, 5 Amp, Form C Switch	E1463A
Service Manual	E1463A 0B3
Solder Eye Terminals	E1463A A3G
3 yr. retn. to Agilent to 1 yr. OnSite Warr.	E1463A W01
Extra Terminal Block	E1463-80011



Agilent E1463A Terminal Block



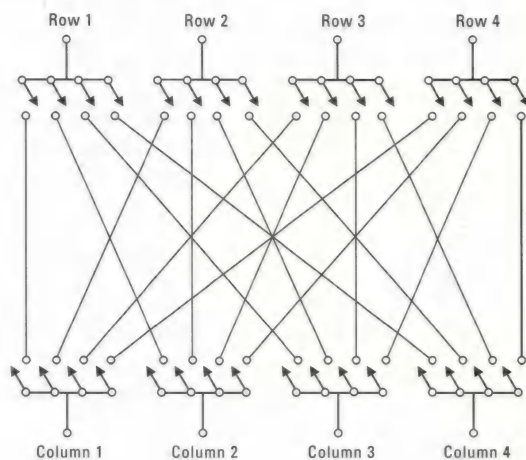
Agilent E1463A Circuit Diagram

Publication No.: 5965-5589E

Overview

4x4 Limited Stubless Matrix

4x4 Limited Stubless Matrix



B-Size Matrix Switch

Product No.	Description
E1361A	4x4 Relay Matrix Switch

C-Size Matrix Switches

Product No.	Description
E8481A	2-Wire, 4x32 Relay Matrix Switch
E1465A	16x16 Relay Matrix Switch
E1466A	4x64 Relay Matrix Switch
E1467A	8x32 Relay Matrix Switch
E1468A	8x8 Relay Matrix Switch
E1469A	4x16 Relay Matrix Switch

Introduction

A matrix switch provides a switch technology with a high degree of flexibility, allowing you to connect multiple combinations of switched points in your test system. Each switched point is connected to a row and column of the matrix. You can then connect any combination of rows to any combination of columns. A matrix is convenient for connecting a group of test instruments to multiple points on a device. Each crosspoint of most matrix modules switches two wires for the high and low of a measurement. Multiple matrix cards can be connected together for applications that require large matrixes—with degraded performance. The bandwidth of a matrix is approximated by the bandwidth of a single crosspoint divided by $1/(\#\text{crosspoints})^{1/2}$.

Since the matrix connects any row to any column, it requires at least as many relays as the product of the number of rows and number of columns. For some test systems applications, it is possible to combine a matrix with a multiplexer to achieve the desired switching topology at lower cost than a total matrix solution.

For matrix applications above 50 MHz, you may need to use a limited stubless switching approach instead of a crossbar matrix. The limited stubless matrix configuration can be achieved using coax multiplexers.

The Family Specifications table in this section provides you with comparative information for each of the Agilent Technologies VXIbus matrix switches.

Overview: Matrix Switch Choices

Agilent Technologies offers several matrix switches for your test system needs. The E1465A, E1466A, and E1467A provide the highest switch density available in Agilent's VXI offering. All three modules offer similar densities, with different row/column sizes and identical performance specifications. Additionally, these modules feature easy expansion to larger matrixes via a chaining cable. The E1465A and E1467A have the best cost-per-crosspoint for large applications.

The E8481A combines high switch density (4x32, 2-wire) with good ac performance. Usable bandwidth (3 dB) is up to 70 MHz for a 4x16 configuration or 55 MHz for a 4x32 configuration.

For high-voltage and high-power capability, the E1468A, E1469A, and E1361A modules are also available. The E1468A and E1469A (C-size) modules have superior crosstalk performance. The E1361A (B-size) module has the highest voltage rating of any Agilent matrix modules.

Family Specifications

Model	E1361A	E1465A ⁽¹⁾	E1466A ⁽¹⁾	E1467A ⁽¹⁾	E1468A	E1469A	E8481A
	4x4 Relay	16x16 Relay	4x64 Relay	8x32 Relay	8x8 Relay	4x16 Relay	4x32 Relay
Input							
Max. Vdc:	250 V	200 V	200 V	200 V	220 V	220 V	42 V
Max. Vac:	250 V	170 V	170 V	170 V	250 V	250 V	30 V rms
Max. Vac peak:	354 V	238 V p-p	238 V p-p	238 V p-p	n/a	n/a	n/a
Max. power per channel:	40 W, VA	30 W	30 W	30 W	n/a	n/a	5 VA
dc							
Maximum thermal offset:	14 μ V	5 μ V	5 μ V	5 μ V	7 μ V	7 μ V	50 μ V
Closed channel resistance (per channel):	<1.5 Ω (typ)	<4.0 Ω (worst crosspoint), <1.8 Ω (best crosspoint)	<4.0 Ω (worst crosspoint), <1.8 Ω (best crosspoint)	<4.0 Ω (worst crosspoint), <1.8 Ω (best crosspoint)	<1.5 Ω (initially)	<1.5 Ω (initially)	<2 Ω initial
Insulation resistance (any two points):							
$\leq 40^\circ \text{C}$, $\leq 95\% \text{RH}$:	n/a	10E8 Ω	10E8 Ω	10E8 Ω	5x10E8 Ω	5x10E8 Ω	n/a
$\leq 40^\circ \text{C}$, $\leq 65\% \text{RH}$:	>10E7 Ω	n/a	n/a	n/a	n/a	n/a	>10E8 Ω
$\leq 25^\circ \text{C}$, $\leq 40\% \text{RH}$:	>10E8 Ω	>10E9 Ω	>10E9 Ω	>10E9 Ω	5x10E8 Ω	5x10E8 Ω	>10E9 Ω
Minimum bandwidth (-3 dB, $Z_L = Z_X = 50 \Omega$):	10 MHz	10 MHz	10 MHz	10 MHz	10 MHz	10 MHz	70 MHz @ 4x16 50 MHz @ 4x32
ac							
Crosstalk (dB, channel-to-channel typical):							
<10 kHz:	n/a	-78	-66	-72	<-90	<-90	n/a
<100 kHz:	<-80	-57	-45	-51	n/a	n/a	-65 dB
<1 MHz:	n/a	-41	-29	-33	n/a	n/a	n/a
<10 MHz:	<-30	n/a	n/a	n/a	n/a	n/a	<-50 dB (5 MHz)
Closed channel capacitance:							
Hi to Lo:	<150 pF ⁽²⁾	<270 pF	<270 pF	<270 pF	650 pF	650 pF	100 pF @ 4x16 160 pF @ 4x32
Hi to chassis:	n/a	<430 pF	<430 pF	<430 pF	n/a	n/a	100 pF @ 4x16 160 pF @ 4x32
Lo to chassis:	<150 pF	<440 pF	<440 pF	<440 pF	700 pF	700 pF	300 pF @ 4x16 550 pF @ 4x32
Minimum relay life no load:	10E6 operations	10E7 operations	10E7 operations	10E7 operations	4x10E6 operations	4x10E6 operations	10E9 operations (rated load 10 mA, 1 Vdc resistive load)
VXI Characteristics							
Size:	B	C	C	C	C	C	C
Slots:	1	1	1	1	1	1	1
VXI device type:	Register based	Register based	Register based	Register based	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.							
VXI plug&play Win Framework:	Yes	Yes	Yes	Yes	Yes	Yes	No
VXI plug&play Win 95/NT Framework:	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VXI plug&play HP-UX Framework:	No	No	No	No	No	No	No

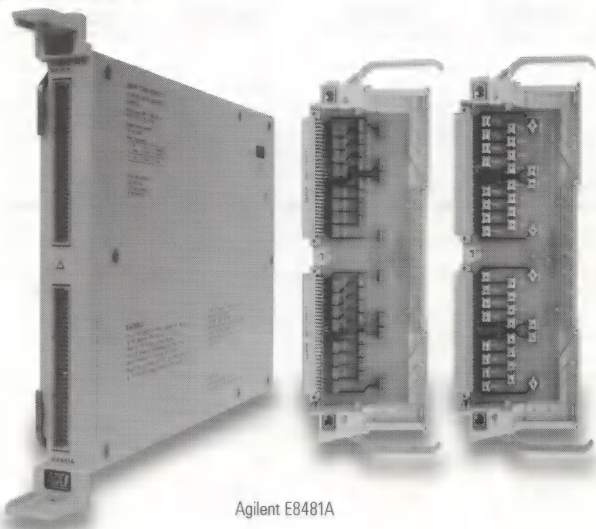
⁽¹⁾ Additional ac performance specifications for the E1465A, E1466A, and E1467A are available on respective data sheets.

⁽²⁾ All contacts closed.

Note: Crosstalk, insulation resistance, and bandwidth specifications are for a single matrix module only. Matrix expansion will degrade these specifications.

2-Wire, 4x32 Relay Matrix Switch

Agilent E8481A



Agilent E8481A

- 1-Slot, C-size, register based
- Ideal for signal switching up to 70 MHz @ 4x16, or 50 MHz @ 4x32
- Flexible dual 4x16 or single 4x32 2-wire matrix
- More than 500 channel lists can be downloaded into onboard memory
- Includes Agilent QUIC easy-to-use terminal blocks
- Non-latching reed relays

Description

The Agilent Technologies E8481A 2-Wire, 4x32 Relay Matrix Switch is a C-size, 1-slot, register-based VXI module. This module switches each crosspoint — both high and low.

The Agilent E8481A can be configured as dual 4x16 matrices or a single 4x32 matrix. Bandwidth (-3 dB) is up to 70 MHz @ 4x16, or 50 MHz @ 4x32 configuration. The E8481A works with two types of Agilent QUIC terminal blocks. The SMB connector terminal block (Option 105) should be used for single-ended systems and higher frequencies. The screw terminal block (Option 106) should be used for two-wire systems and lower frequencies. Either terminal block must be ordered separately as an option to the E8481A; the standard E8481A includes no terminal block.

You can store up to 511 complete channel lists, or complete matrix configurations of opened/closed switches, in on-board E8481A memory. This allows switch module states to be recalled quickly and easily without long, complex programming commands.

The Agilent E8481A is ideal for switching signals to oscilloscopes, counters, and signal sources in your test system.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Maximum V (term to term):	
dc:	42 V
ac rms:	30V
Maximum transient impulse:	
Vpk:	500 V
Maximum I (per channel, non-inductive):	
dc:	0.5 A
ac peak:	0.5 A
Maximum power:	
Per channel:	5 VA
Per module:	40 VA

dc

Maximum thermal offset:	50 μ V
Closed channel resistance (per channel):	<2 Ω initial
Insulation resistance (any two points):	
$\leq 40^\circ \text{C}$, $\leq 65\% \text{RH}$:	>10E8 Ω
$\leq 25^\circ \text{C}$, $\leq 40\% \text{RH}$:	>10E9 Ω

ac

Minimum bandwidth	70 MHz @ 4x16
(-3 dB, $Z_L=Z_X=50 \Omega$):	50 MHz @ 4x32
Crosstalk (dB, channel-to-channel typical):	
<100 KHz:	<-65 dB
<5 MHz:	<-50 dB
<50 MHz:	<-27 dB
Closed-channel capacitance:	
Hi to Lo:	100 pF @ 4x16
	160 pF @ 4x32
Hi to chassis:	100 pF @ 4x16
	160 pF @ 4x32
Lo to chassis:	300 pF @ 4x16
	550 pF @ 4x32

General

Typical relay life (rated load)*:	10E9 operations
Screw terminal wire size:	AWG 18 to AWG 26

*10 mA, 1 Vdc resistive load

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, Slave only
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.11.01
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

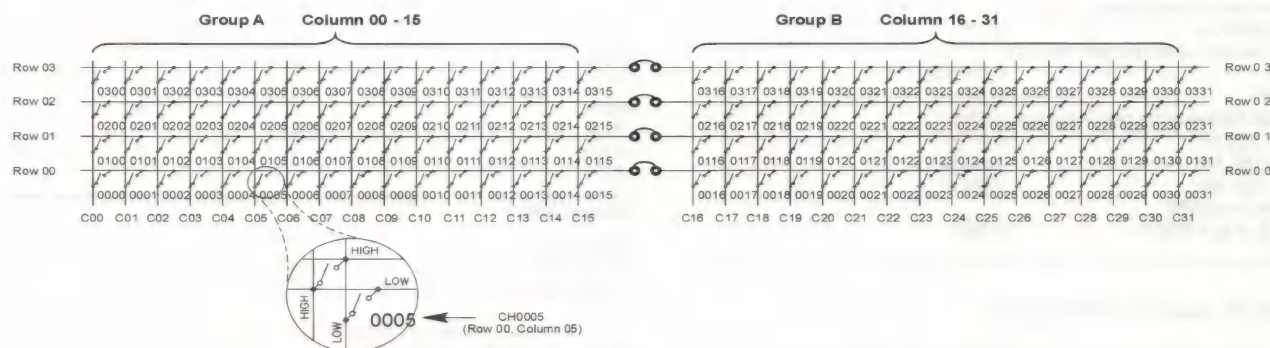
Watts/slot:	13 (8 crosspoints closed)*
ΔP mm H₂O:	0.1
Air flow liter/s:	1.1

*Add 0.34 W per crosspoint when more than 8 crosspoints are closed.

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	2.21	0.10
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

(Agilent E8481A continued)



Agilent E8481A Crosspoint Switches Hi and Lo

Ordering Information

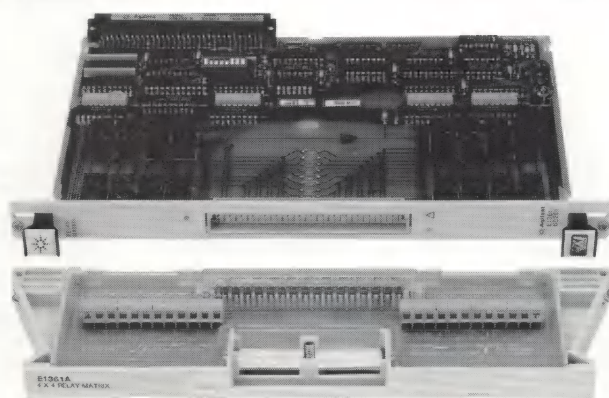
Description	Product No.
2-Wire, 4x32 Relay Matrix Switch	E8481A*
SMB Terminal Block	E8481A 105
Screw Terminal Block	E8481A 106
3 yr. Retn. to Agilent to 1 yr. OnSite warr.	E8481A W01

*Does not include a terminal block. To receive a terminal block, you must order either Option 105 or Option 106.

Publication No.: 5988-1406EN

2-Wire 4x4 Relay Matrix Switch

Agilent E1361A



Agilent E1361A

- 1-Slot, B-size, register based
- Multiple inputs connect to multiple outputs
- Flexible dual 2x4 or single 4x4 2-wire matrix
- 250 V, 1 A dc or ac signal switching, latching relays
- Modules connect for larger matrixes
- Each crosspoint switches two-wire, Hi and Lo

Description

The Agilent Technologies E1361A Relay Matrix Switch is a B-size, 1-slot, register-based VXI module. It consists of 16 latching relays arranged as a 4x4 matrix. The 4x4 matrix can be reconfigured as a dual 2x4 matrix by removing factory-installed jumpers. Capable of switching voltages up to 250 Vdc and 354 Vpk, the E1361A Relay Matrix Switch has the highest voltage rating of any Agilent matrix module.

All relays remain in their programmed state during power-down and are reset at power-on. After reset, all relays are open. Each crosspoint switches 2-wire, Hi and Lo. The E1361A can be reconfigured as an 8:1, 2-wire multiplexer.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Maximum voltage (any terminal to any other terminal or chassis):

dc:	250 V
ac rms:	250 V
Peak:	354 V

Maximum Current
(per channel common, non-inductive):

n/a

Maximum power:

Per channel:	40 W
Per module:	320 W, 960 VA

20

(Agilent E1361A continued)

dc

Maximum thermal offset per channel, differential Hi-Lo:	14 μ V
Closed channel resistance (per channel):	
Initial:	<1.5 Ω (typ)
End of life:	<3.5 Ω
Insulation resistance (between any two points):	
$\leq 40^\circ$ C, $\leq 95\%$ RH:	n/a
$\leq 40^\circ$ C, $\leq 65\%$ RH:	>10E7 Ω
$\leq 25^\circ$ C, $\leq 40\%$ RH:	>10E8 Ω
Minimum bandwidth (-3 dB, $Z_L = Z_X = 50 \Omega$):	10 MHz

ac

Crosstalk (dB, channel-to-channel typical):

Note: Crosstalk, insulation resistance, and bandwidth specifications are for a single matrix module only. Matrix expansion will degrade these specifications.

<10 kHz:	n/a
<100 kHz:	<-80
<1 MHz:	n/a
<10 MHz:	<-30
Closed channel capacitance:	
Hi-Lo:	<150 pF (All contacts closed)
Hi-Chassis:	<150 pF
Lo-Chassis:	<150 pF
Hi-Hi:	<20 pF
Insertion loss:	<0.1 dB @ ≤ 100 kHz <3 dB @ ≤ 10 MHz

General

Minimum relay life:	
No load:	10E6 operations
Screw terminal wire size:	16 AWG (15 mm) max

General Specifications**VXI Characteristics**

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

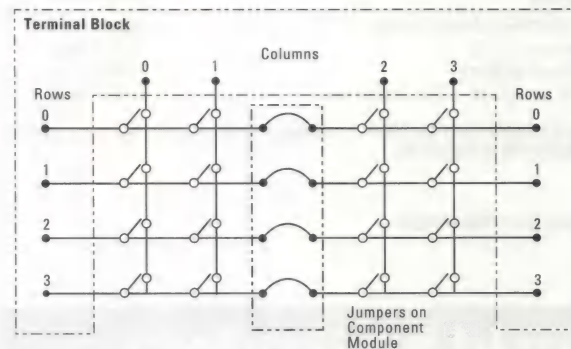
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.24	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

Ordering Information

Description	Product No.
2-Wire 4x4 Relay Matrix	E1361A
Service Manual	E1361A 0B3
Japan - Japanese Localization	E1361A ABJ
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1361A W01
Extra terminal block for the E1361A	E1361-80001

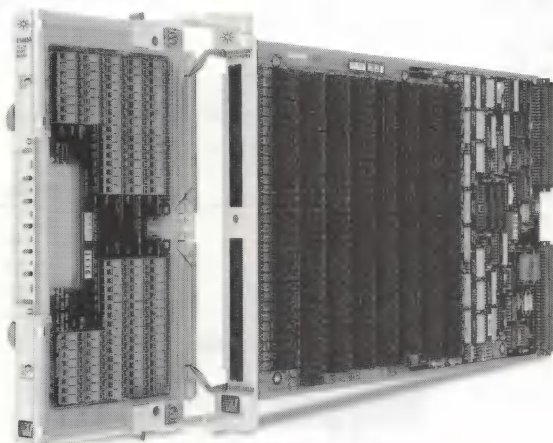


E1361A Each crosspoint switches 2-wire, Hi and Lo

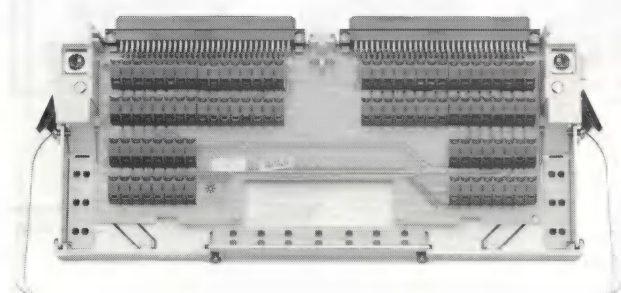
Publication No.: 5965-5590E

16x16 Relay Matrix Switch

Agilent E1465A



Agilent E1465A



- 1-Slot, C-size, register based
- 16x16 two-wire switching matrix
- Rows and columns expand to make larger matrixes
- 1 A, 200-V signal switching
- Downloadable channel lists into onboard memory
- Includes QUIC easy-to-use terminal blocks

Description

The Agilent Technologies E1465A Relay Matrix Switch is a C-size, 1-slot, register-based VXI module. This 16x16 matrix switches each crosspoint both high and low. The E1465A features easy expansion to larger matrixes via a chaining cable that allows you to interconnect rows and columns on different modules. A full E1401B 13-slot mainframe can have up to 3072 two-wire crosspoints.

The E1465A module provides the best cost-per-crosspoint for large matrix applications. It shares the same switch card with the E1466A and E1467A; each product's unique terminal block determines the matrix configuration. Therefore, you can change matrix topology simply by plugging in the various terminal blocks. The terminal blocks can be obtained separately. Creating a matrix as large as 32x32 requires four matrix modules and interconnected rows and columns on the terminal blocks. All the E1465/66/67A matrix modules offer similar densities, with different row/column sizes and identical performance specifications. All specifications are identical for this family, except for crosstalk.

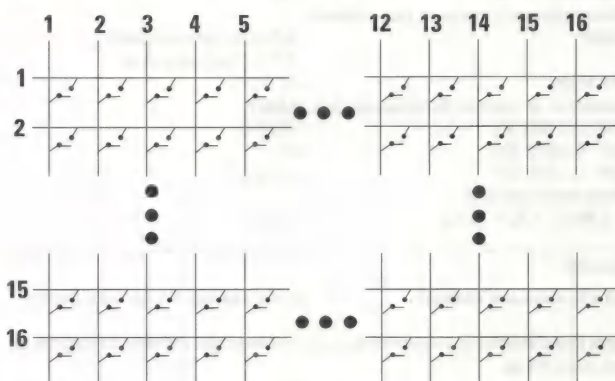
Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

You can create a larger matrix by adding one or more matrix modules and interconnecting either the E1465A rows or columns on the terminal blocks with the E1466-80002 daisy-chain expansion cable. You can interconnect the E1465A rows with the rows of either the E1466A or E1467A. (Only the E1465A allows column expansion.) To create a 32x32 matrix with four E1465A modules requires 16 daisy-chain expansion cables connected together.

A preferable solution for a large matrix with easier cable access is to purchase the E1467A with an expansion terminal block (Option 201/211) and Z2220A series cables.

The E1467A Option 201/211 Matrix Expansion Terminal Block provides an 8x32 configuration that can easily be expanded. Compared to the daisy-chain cable (which requires each wire to be screwed into the screw terminal), the E1467A Opt 201/211 terminal block gives you quicker access and easier cable connections.



E1465A Each crosspoint switches Hi and Lo

Product Specifications

ac Performance

ac specifications apply with no more than one crosspoint closed per row or column. Specifications are for 16 x 16 matrix, for $Z(\text{load}) = Z(\text{source}) = 50 \Omega$. Specifications are for worst crosspoint. Matrix expansion degrades crosstalk and bandwidth performance. Typical is defined as the worst crosspoint test result from one or two matrix modules. If guaranteed specifications are necessary, contact your local sales representative.

Crosstalk (dB) within a card (worst path):

	<10 kHz	<100 kHz	<1 MHz
Closed path to closed path (typical):	-78 dB	-57 dB	-41 dB
Open row to open row (typical):	-93 dB	-73 dB	-56 dB
Open row to open column (typical):	-84 dB	-63 dB	-47 dB
Open column to open column (typical):	-86 dB	-65 dB	-48 dB

Crosstalk (dB) module-to-module

(represents 16 x 32 configuration):

Chaining cable used to connect modules (P/N E1466-80002).

	<10 kHz	<100 kHz	<1 MHz
Closed path to closed path (typical):	-78 dB	-58 dB	-43 dB
Open row to open row (typical):	-84 dB	-66 dB	-52 dB
Open row to open column (typical):	-84 dB	-63 dB	-48 dB
Open column to open column (typical):	-93 dB	-72 dB	-48 dB

Crosstalk (dB) Closed channel capacitance (<10 kHz):

Hi to Lo:	<270 pF
Hi to Ground:	<430 pF
Lo to Ground:	<440 pF

(Agilent E1465A continued)

Input**Maximum voltage (any terminal to any other terminal or chassis):**

dc:	200 V
ac rms:	170 V
Peak:	238 V p-p

Maximum current**(per channel common, non-inductive):**

1 Adc; 1 Aac peak

Maximum power:

Per channel:	30 W
Per module:	62.5 VA (resistive load)

dc**Maximum thermal offset per channel, differential Hi-Lo:**5 μ V**Closed channel resistance (per channel):**

Initial:	<4.0 Ω (worst crosspoint) <1.8 Ω (best crosspoint)
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End of life:

<10.0 Ω **Insulation resistance (between any two points):**

$\leq 40^\circ$ C, $\leq 95\%$ RH:	>10E8 Ω
$\leq 40^\circ$ C, $\leq 65\%$ RH:	n/a
$\leq 25^\circ$ C, $\leq 40\%$ RH:	>10E9 Ω

Minimum bandwidth**(-3 dB, $Z_L = Z_X = 50 \Omega$):**

10 MHz

General**Time to close one channel:** 8.9 ms (Agilent V/743 and C-SCPI)**Note:** When downloading a channel list to card memory, you can close all columns in one row in 8.9 ms.**Power-down state:** Relay states are unchanged at power-down.**Power-up state:** Relays open at power-up**Minimum relay life:** 10E7 operations**Screw terminal wire size:** 18 to 26 AWG (1.2, 0.9, 0.75, 0.6, 0.5 mm)**General Specifications****VXI Characteristics**

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

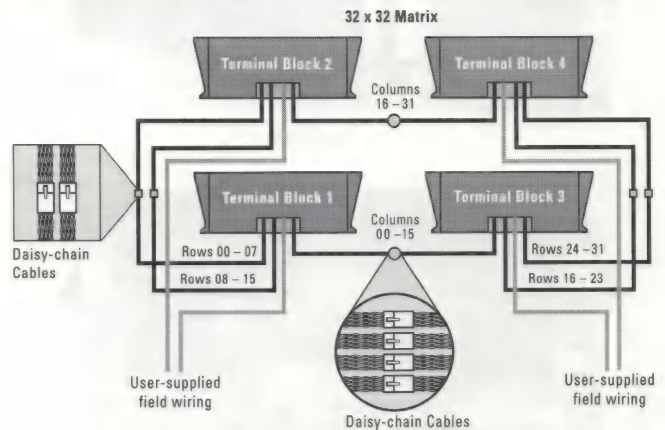
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.18	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	5.00
ΔP mm H₂O:	0.08
Air Flow liter/s:	0.42

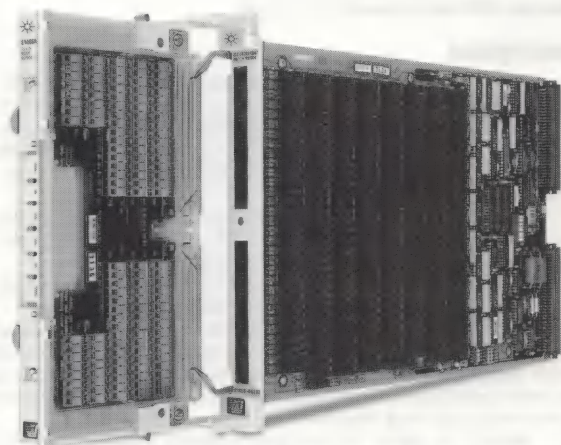
Ordering Information

Description	Product No.
16x16 Relay Matrix Module	E1465A
Service Manual	E1465A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1465A W01
Extra Terminal Block, 16x16 Relay Matrix, QUIC	E1465-80010
Daisy Chain Cable Kit	E1466-80002



Four E1465A matrix terminal blocks wired as 32 x 32 matrix

Publication No.: 5965-5591E

4x64 Relay Matrix Switch**Agilent E1466A**

Agilent E1466A

- 1-Slot, C-size, register based
- 4x64 two-wire switching matrix, latching relays
- Rows expand to make larger matrixes
- Downloadable channel lists into onboard memory
- Includes QUIC easy-to-use terminal blocks
- Latching armature relay

(Agilent E1466A continued)

Description

The Agilent Technologies E1466A Relay Matrix Switch is a **C-size, 1-slot, register-based VXI module**. This 4x64 matrix switches each crosspoint—both high and low. The E1466A module provides the best cost-per-crosspoint for large matrix applications. It features easy expansion to larger matrixes via a chaining cable that allows you to interconnect rows and columns on different modules. A full E1401B 13-slot mainframe can have up to 3072 two-wire crosspoints.

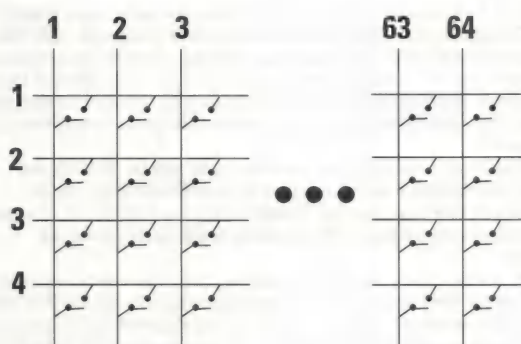
The E1466A shares the same switch card with the E1465A and E1467A; each product's unique terminal block determines the matrix configuration. Therefore, you can change matrix topology simply by plugging in the various terminal blocks, which can be obtained separately. Creating a matrix as large as 4x256 requires four matrix modules and interconnected rows and columns on the terminal blocks. All of the E1465/66/67A matrix modules offer similar densities, with different row/column sizes and identical performance specifications. All specifications are identical for this family, except for crosstalk.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

You can create a larger matrix by adding one or more matrix modules and interconnecting the E1466A rows on the terminal blocks with the E1466-80002 daisy-chain expansion cable. You can interconnect the E1466A rows with the rows of another E1465A, E1466A, or an E1467A. To create a 4x256 matrix with four E1466A modules requires three daisy-chain expansion cables connected as shown.

A preferable solution for large matrixes is to use the E1467A with an expansion terminal block (Option 201/211) and Z2220A series cables. The E1467A Option 201/211 matrix expansion terminal block provides an 8x32 matrix configuration that can easily be expanded. Compared to the daisy-chain cable (which requires each wire to be screwed into the screw terminal), the E1467A Opt 201/211 terminal block gives you quicker access and easier cable connections.



E1466A Each crosspoint switches Hi and Lo

Product Specifications

ac Performance

ac specifications apply with no more than one crosspoint closed per row or column. Specifications are for 4x64 matrix, for $Z(\text{load}) = Z(\text{source}) = 50 \Omega$. Specifications are for worst crosspoint. Matrix expansion degrades crosstalk and bandwidth performance. Typical is defined as the worst crosspoint test result from one or two matrix modules. If guaranteed specifications are necessary, contact your local sales representative.

Crosstalk (dB) within a card (worst path):

	<10 kHz	<100 kHz	<1 MHz
Closed path to closed path (typical):	-66 dB	-45 dB	-29 dB
Open row to open row (typical):	-73 dB	-52 dB	-37 dB
Open row to open column (typical):	-84 dB	-64 dB	-47 dB
Open column to open column (typical):	-92 dB	-70 dB	-52 dB

Crosstalk (dB) module-to-module
(represents 4 x 128 configuration):

	<10 kHz	<100 kHz	<1 MHz
Closed path to closed path (typical):	-66 dB	-45 dB	-29 dB
Open row to open row (typical):	-68 dB	-46 dB	-29 dB
Open row to open column (typical):	-84 dB	-64 dB	-48 dB
Open column to open column (typical):	-92 dB	-71 dB	-52 dB

Closed channel capacitance (<10 kHz):

Hi to Lo:	<270 pF
Hi to Ground:	<430 pF
Lo to Ground:	<440 pF

Minimum bandwidth

(-3 dB, $Z_L = Z_X = 50 \Omega$):	10 MHz
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Input

Maximum voltage (any terminal to any other terminal or chassis):

dc:	200 V
ac rms:	170 V
Peak:	238 V p-p

Maximum current

(per channel common, non-inductive):

1 Adc; 1 Aac peak

Maximum power:

Per channel:	30 W
Per module:	62.5 VA (resistive load)

dc

Maximum thermal offset per channel,

differential Hi-Lo: 5 μ V

Closed channel resistance (per channel):

Initial:	<4.0 Ω (worst crosspoint)
	<1.8 Ω (best crosspoint)
End of life:	<10.0 Ω

Insulation resistance (between any two points):

$\leq 40^\circ \text{C}$, $\leq 95\% \text{RH}$:	>10E8 Ω
$\leq 40^\circ \text{C}$, $\leq 65\% \text{RH}$:	n/a
$\leq 25^\circ \text{C}$, $\leq 40\% \text{RH}$:	>10E9 Ω

General

Time to close one channel: 8.9 ms (Agilent V/743 and C-SCPI)

Note: When downloading a channel list to card memory, you can close all columns in one row in 8.9 ms.

Power-down state:

Relay states are unchanged at power-down.

Power-up state:

Relays open at power-up.

Minimum relay life:

No load: 10E7 operations

Screw terminal wire size: 18 to 26 AWG (1.2, 0.9, 0.75, 0.6, 0.5 mm)

(Agilent E1466A continued)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I _{PM}	I _{DM}
+5 V:	0.1	0.01
+12 V:	0.18	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	5.00
ΔP mm H ₂ O:	0.08
Air Flow liter/s:	0.42

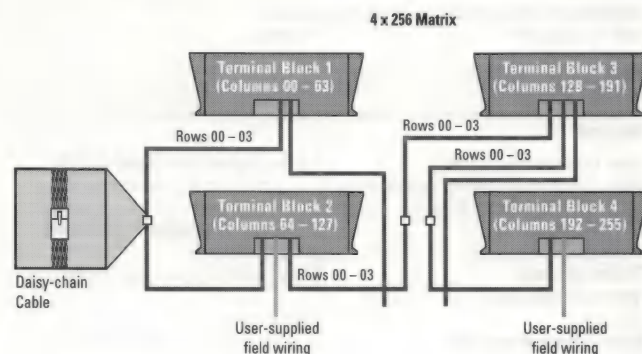
Ordering Information

Description

4x64 Relay Matrix Module
Service Manual
3 yr. Retn. to 1 yr. OnSite Warr.
Extra Term Block Assy, QUIC
Daisy Chain Cable Kit

Product No.

E1466A
E1466A 0B3
E1466A W01
E1466-80010
E1466-80002

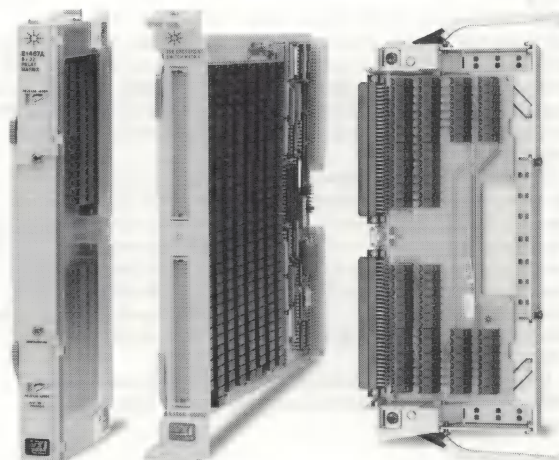


Four E1466A matrix terminal blocks wired as a 4x256 matrix

Publication No.: 5965-5592E

8x32 Relay Matrix Switch

Agilent E1467A



Agilent E1467A

- 1-Slot, C-size, register based
- 8x32 two-wire switching matrix, latching relays
- Rows expand to make larger matrixes
- Downloadable channel lists into onboard memory
- Includes QUIC easy-to-use terminal blocks
- Latching armature relay

Description

The Agilent Technologies E1467A relay matrix is a C-size, 1-slot, register-based VXI module. This 8x32 matrix switches each crosspoint—both high and low. The E1467A features easy expansion to larger matrixes via a chaining cable that allows you to interconnect rows and columns on different modules. A full E1401B 13-slot mainframe can have up to 3072 two-wire crosspoints. The E1467A module provides the best cost-per-crosspoint for large matrix applications.

The E1467A shares the same switch card with the E1465A and E1466A; each product's unique terminal block determines the matrix configuration. Therefore, you can change matrix topology simply by plugging in the various terminal blocks. The terminal blocks can be obtained separately.

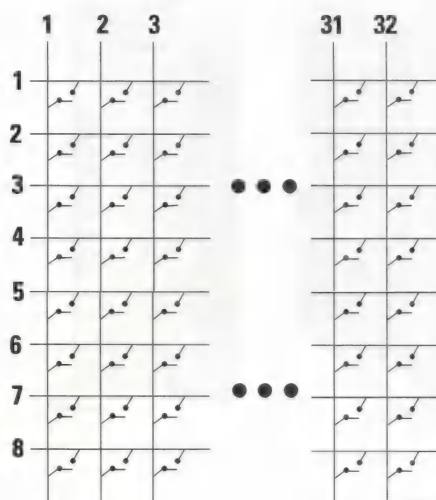
Creating a matrix as large as 8x96 requires three matrix modules and interconnected rows and columns on the terminal blocks. All the E1465/66/67A matrix modules offer similar densities, with different row/column sizes and identical performance specifications. All specifications are identical for this family, except for crosstalk.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

You can create a larger matrix by adding one or more matrix modules and interconnecting the E1467A rows on the terminal blocks with the 280 mm E1466-80002 daisy-chain expansion cable. You can interconnect the E1467A rows with the rows of another E1467A or an E1466A. To create an 8x96 matrix with four E1467A modules requires four daisy-chain expansion cables connected as shown.

(Agilent E1467A continued)



Product Specifications

ac Performance

ac specifications apply with no more than one crosspoint closed per row or column. Specifications are for 8x32 matrix, for $Z(\text{load}) = Z(\text{source}) = 50 \Omega$. **Note:** Specifications are for worst crosspoint. Matrix expansion degrades crosstalk and bandwidth performance. Typical is defined as the worst crosspoint test from one or two matrix modules. If guaranteed specifications are necessary, contact your local sales representative.

Crosstalk (dB) within a card (worst path):

	<10 kHz	<100 kHz	<1 MHz
Closed Path to Closed Path (typical):	-72 dB	-51 dB	-33 dB
Open row to open row (typical):	-91 dB	-59 dB	-43 dB
Open row to open column (typical):	-85 dB	-64 dB	-47 dB
Open column to open column (typical):	-92 dB	-71 dB	-54 dB

Crosstalk (dB) module-to-module (represents 8x64 configuration):

Note: Chaining cable used to connect modules (P/N E1466-80002).

	<10 kHz	<100 kHz	<1 MHz
Closed Path to Closed Path (typical):	-72 dB	-51 dB	-33 dB
Open row to open row (typical):	-74 dB	-53 dB	-38 dB
Open row to open column (typical):	-92 dB	-72 dB	-56 dB
Open column to open column (typical):	-82 dB	-64 dB	-50 dB

Closed channel capacitance (<10 kHz):

Hi to Lo:	<270 pF
Hi to Ground:	<430 pF
Lo to Ground:	<440 pF

Minimum bandwidth

(-3 dB, $Z_L = Z_X = 50 \Omega$): 10 MHz

Input

Maximum voltage (any terminal to any other terminal or chassis):

dc:	200 V
ac rms:	170 V
Peak:	238 V p-p

Maximum current

(per channel common, non-inductive):

1 Adc; 1 Aac peak

Maximum power:

Per channel:	30 W
Per module:	62.5 VA (resistive load)

dc

Maximum thermal offset per channel,

differential Hi-Lo: 5 μ V

Closed channel resistance (per channel):

Initial: <4.0 Ω (worst crosspoint)
<1.8 Ω (best crosspoint)

End of life: <10.0 Ω

Insulation resistance (between any two points):

$\leq 40^\circ \text{C}$, $\leq 95\% \text{RH}$: >10E8 Ω
 $\leq 40^\circ \text{C}$, $\leq 65\% \text{RH}$: n/a
 $\leq 25^\circ \text{C}$, $\leq 40\% \text{RH}$: >10E9 Ω

General

Time to close one channel: 8.9 ms (Agilent V/743 and C-SCPI)

Note: When downloading a channel list to card memory, you can close all columns in one row in 8.9 ms.

Power-down state: Relay states are unchanged at power-down.

Power-up state: Relays open at power-up.

Minimum relay life:

No load: 10E7 operations

Screw terminal wire size: 18 to 26 AWG (1.2, 0.9, 0.75, 0.6, 0.5 mm)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable

Command module firmware rev: A.08

I-SCPI Win 3.1: Yes

I-SCPI Series 700: Yes

C-SCPI LynxOS: Yes

C-SCPI Series 700: Yes

Panel Drivers: Yes

VXIplug&play Win Framework: Yes

VXIplug&play Win 95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

Module Current

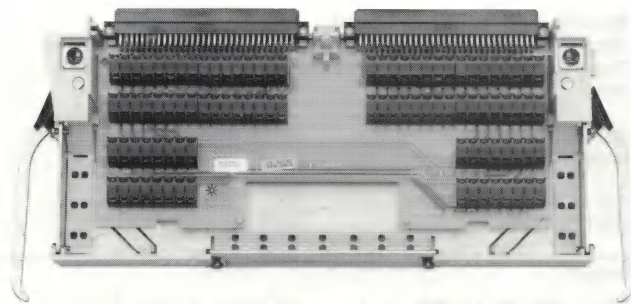
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.18	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

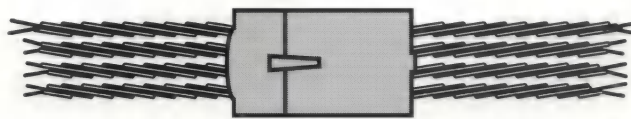
Watts/slot:	5.00
ΔP mm H ₂ O:	0.08
Air Flow liter/s:	0.42

Ordering Information

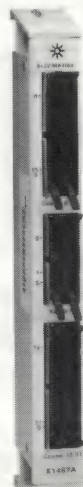
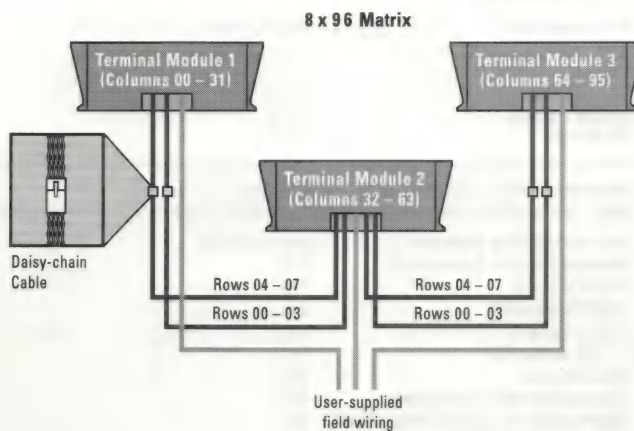
Description	Product No.
8x32 Relay Matrix Module	E1467A
Service Manual	E1467A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1467A W01
Daisy Chain Cable Kit	E1466-80002
Extra Terminal Block Assembly, QUIC	E1467-80010



Three E1467A matrix terminal blocks wired as an 8x96 matrix



Daisy Chain Cable: E1468-80002

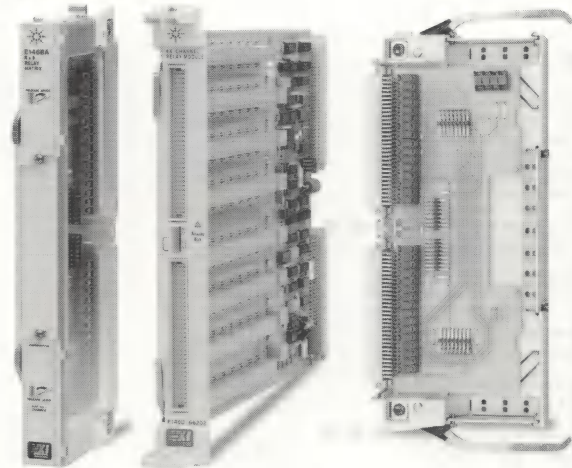


E1467A Opt 201 Matrix Expansion Terminal Block

Publication No.: 5965-5593E

8x8 Relay Matrix Switch

Agilent E1468A



Agilent E1468A

- 1-Slot, C-size, register based
- Connect multiple inputs to multiple outputs
- 8x8 and 4x16 two-wire switching
- Guard or shield available for each row and column
- Includes QUIC easy-to-use terminal block
- Latching relays

Description

The Agilent Technologies E1468A matrix module is a C-size, 1-slot, register-based VXI module. This module consists of a 64-channel, two-wire relay component card (uses the same component card as the E1460A). A terminal block, that provides 8x8 matrix topology, is included. The E1468A matrix switches both high and low on each crosspoint.

Multiple modules can easily be interconnected with the E1468-80002 daisy-chain cable. The E1468-80002 daisy-chain cable allows quick connect and disconnect of one module from another and is easily attached to expansion connectors on the E1468A terminal blocks. For applications requiring more than 64 crosspoints, the E1465/66/67A relay matrixes are recommended unless your application requires the high voltage/power capability and superior crosstalk performance of the E1468A matrix.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

The E1468-80002 daisy-chain cable allows quick connect and disconnect of one module from another and is easily attached to expansion connectors on the E1468/69A terminal blocks. For a 4x48 matrix, order three daisy-chain cables to interconnect three E1469As. For a 16x16 matrix, order eight daisy-chain cables to interconnect four E1468As. Similarly, to interconnect three E1468As into an 8x24 matrix, order four daisy-chain cables. Check to see whether the high density E1465/66/67A family is a better fit for your application.

Product Specifications

Input

Maximum voltage (any terminal to any other terminal or chassis):

dc:	220 V
ac rms:	250 V
Peak:	n/a

Maximum current (per channel common, non-inductive):

1 Adc or ac rms
(V<30 Vdc/rms),
0.3 Adc or ac rms
(V<220 Vdc/rms)

Maximum power:

Per channel:	n/a
Per module:	40 VA

(Agilent E1468A continued)

dc**Maximum thermal offset per channel,****differential Hi-Lo:** 7 μ V**Closed channel resistance (per channel):**Initial: <1.5 Ω (initially)End of life: <3.5 Ω **Insulation resistance (between any two points):** $\leq 40^\circ$ C, 95% RH: $5 \times 10^8 \Omega$ $\leq 40^\circ$ C, 65% RH: n/a $\leq 25^\circ$ C, $\leq 40\%$ RH: $5 \times 10^8 \Omega$ **ac****Minimum bandwidth**(-3 dB, $Z_L = Z_X = 50 \Omega$): 10 MHz, 25 MHz (typical)**Crosstalk (dB, channel-to-channel typical):**

<10 kHz: <-90

<100 kHz: n/a

<1 MHz: n/a

<10 MHz: n/a

Closed channel capacitance:

Hi-Lo: 650 pF

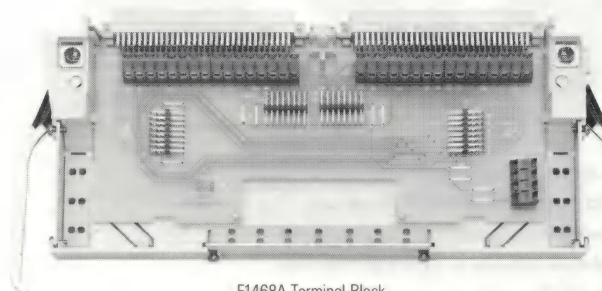
Lo-Chassis: 700 pF

Note: Crosstalk, insulation resistance, and bandwidth specifications are for a single matrix module only. Matrix expansion will degrade these specifications.**General****Minimum relay life:**No Load: 4×10^6 operations**Screw terminal wire size:** 18 to 26 AWG (1.2, 0.9, 0.75, 0.6, 0.5 mm)**Bias current:** <0.5 nA/Volt (at 25° C, 25% RH)
(From HI or LO to chassis, per group of 16 channels)**General Specifications****VXI Characteristics****VXI device type:** Register based, A16, slave only**Size:** C**Slots:** 1**Connectors:** P1/2**Shared memory:** None**VXI buses:** TTL trigger bus**Instrument Drivers** - See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.**Command module firmware:** Downloadable**Command module firmware rev:** A.04**I-SCPI Win 3.1:** Yes**I-SCPI Series 700:** Yes**C-SCPI LynxOS:** Yes**C-SCPI Series 700:** Yes**Panel Drivers:** Yes**VXIplug&play Win Framework:** Yes**VXIplug&play Win 95/NT Framework:** Yes**VXIplug&play HP-UX Framework:** No**Module Current**

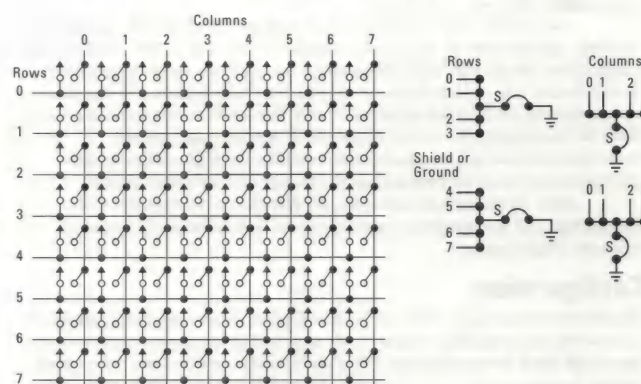
	I_{PM}	I_{DM}
+5 V:	0.1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot**Watts/slot:** 5.00 ΔP mm H₂O: 0.08**Air Flow liter/s:** 0.42**Ordering Information**

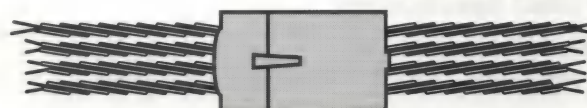
Description	Product No.
8x8 Relay Matrix Switch	E1468A
Service Manual	E1468A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1468A W01
Extra Terminal Block, QUIC	E1468-80011



E1468A Terminal Block

E1468A Each Crosspoint Switches 2-Wire Hi and Lo

E1468A Matrix Diagram



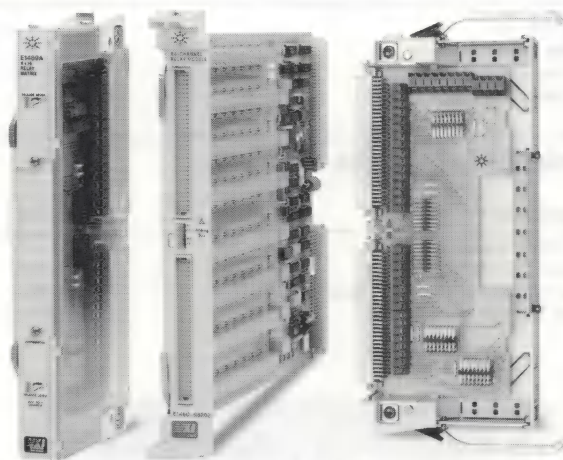
Daisy Chain Cable: E1468-80002

Publication No.: 5965-5594E

20

4x16 Relay Matrix Switch

Agilent E1469A



Agilent E1469A

- 1-Slot, C-size, register based
- Connect multiple inputs to multiple outputs
- 4x16 two-wire switching with a guard or shield
- Expand rows/columns to make larger matrices
- Includes QUIC easy-to-use terminal block
- Latching relays

Description

The Agilent Technologies E1469A matrix is a C-size, 1-slot, register-based VXI module. This module consists of a 64-channel two-wire relay component card (same component card as the E1460A). A terminal block, which provides 4x16 matrix topology, is included.

The E1469A matrix switches both high and low on each crosspoint. Multiple modules can easily be interconnected with the E1468-80002 daisy-chain cable. The E1468-80002 daisy-chain cable allows quick connect and disconnect of one module from another and is easily attached to expansion connectors on the E1469A terminal blocks. For applications requiring more than 64 crosspoints, the newer E1465/66/67A relay matrices are recommended unless your application requires the high voltage/power capability and superior crosstalk performance of the E1469A matrix.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

The E1468-80002 daisy-chain cable allows quick connect and disconnect of one module from another and is easily attached to expansion connectors on the E1468/69A terminal blocks. For a 4x48 matrix, order three daisy-chain cables to interconnect three E1469As. For a 16x16 matrix, order eight daisy-chain cables to interconnect four E1468As. Similarly, to interconnect three E1468As into an 8x24 matrix, order four daisy-chain cables. Check to see whether the higher density E1465/66/67A family is a better fit for your application.

Product Specifications

Input

Maximum voltage (any terminal to any other terminal or chassis):

dc:	220 V
ac rms:	250 V
Peak:	n/a

Maximum current (per channel common, non-inductive):

1 Adc or ac rms
(V<30 Vdc/rms),
0.3 Adc or ac rms
(V<220 Vdc/rms)

Maximum power:

Per channel:	n/a
Per module:	40 VA

dc

Maximum thermal offset per channel,

differential Hi-Lo: 7 μ V

Closed channel resistance (per channel):

Initial: <1.5 Ω (initially)

End of life: <3.5 Ω

Insulation resistance (between any two points):

$\leq 40^\circ$ C, $\leq 95\%$ RH: 5 x 10E8 Ω

$\leq 40^\circ$ C, $\leq 65\%$ RH: n/a

$\leq 25^\circ$ C, $\leq 40\%$ RH: 5 x 10E8 Ω

ac

Minimum bandwidth

(-3 dB, $Z_L = Z_X = 50 \Omega$): 10 MHz
25 MHz (typical)

Crosstalk (dB, channel-to-channel typical):

<10 kHz: <-90

<100 kHz: n/a

<1 MHz: n/a

<10 MHz: n/a

Closed channel capacitance:

Hi-Lo: 650 pF

Lo-Chassis: 700 pF

Note: Crosstalk, insulation resistance, and bandwidth specifications are for a single matrix module only. Matrix expansion will degrade these specifications.

General

Minimum relay life:

No load: 4x10E6 operations

Screw terminal wire size: 18 to 26 AWG (1.2, 0.9, 0.75, 0.6, 0.5 mm)

Bias current: <0.5 nA/Volt (at 25° C, 25% RH)

(From HI or LO chassis, per group of 16 channels)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	TTL trigger bus

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.04
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

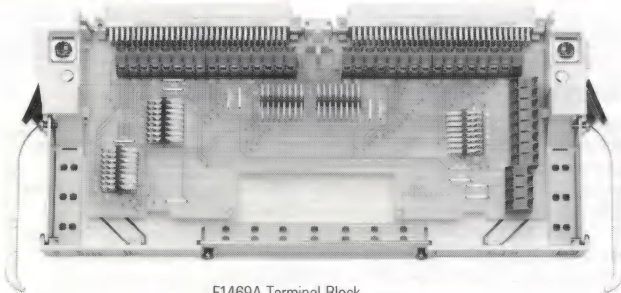
(Agilent E1469A continued)

Cooling/Slot

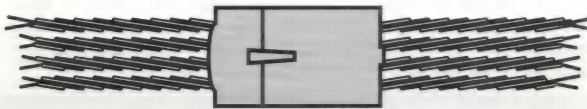
Watts/slot:	5.00
ΔP mm H ₂ O:	0.08
Air Flow liter/s:	0.42

Ordering Information

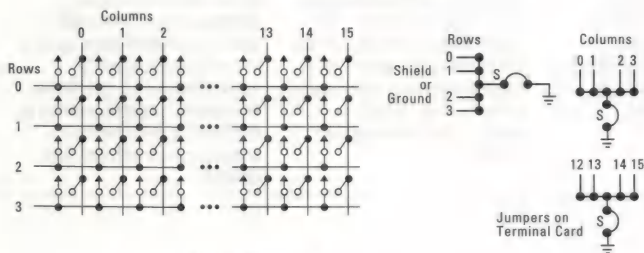
Description	Product No.
4x16 Relay Matrix Switch	E1469A
Service Manual	E1469A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1469A W01
Daisy Chain Cable Kit	E1468-61601
Extra Terminal Block Assembly, QUIC	E1469-80011



E1469A Terminal Block



Daisy Chain Cable: E1468-80002

E1469A Each Crosspoint Switches 2-Wire Hi and Lo

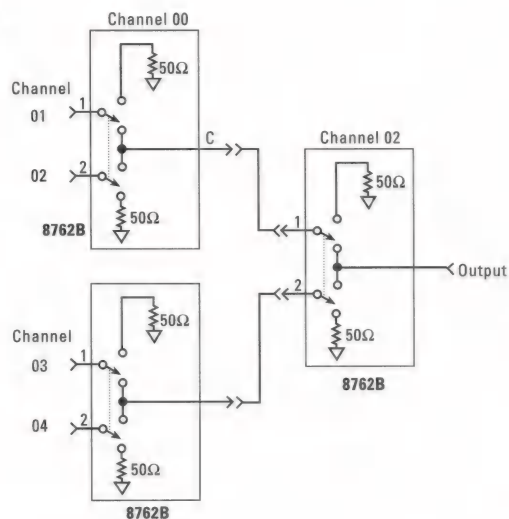
E1469A Circuit Diagram

Publication No.: 5965-5595E

Overview

4 x 1 Microwave Switch Example

4x1 MW Switch



B-Size Microwave Switches

Product No.	Description
E1368A	18 GHz Microwave Switch 3 Channels
E1369A	Microwave Switch Driver
E1370A	Microwave Switch / Attenuator Driver

C-Size Microwave Switch

Product No.	Description
E8483A	Microwave Switch / Attenuator Driver

Introduction

Agilent Technologies provides a number of VXI modules that allow you to switch microwave signals, or to control a variety of microwave switches and attenuators. Several kinds of switches and step attenuators can be controlled for signals up to 26.5 GHz. These switches provide low insertion loss and come in single-pole, single-throw or single-pole multi-throw configurations. The Family Specifications table in this section provides comparative information.

Overview: Microwave Switch Choices

Agilent offers four VXI microwave switch modules. The E1368A comes factory wired with three 8762B 18 GHz microwave switches. These break-before-make coaxial switches have latching solenoids so that the coil is energized only during the switching operation. A connector is available for cabling to two additional remote mounted switches.

The E8483A allows you to control up to six microwave switches or step attenuators, allowing you to place these devices near your DUT to optimize signal quality. Up to three cylindrical single-pole, multi-throw switches can be mounted inside the module to minimize space consumed.

The E1369A Microwave Switch Driver module allows you to drive up to five switches – three inside the VXI module – microwave switches from the 8762B/C, 8763B/C, 8764B/C switch family. Other manufacturers having equivalent microwave switches are mentioned in the E1369A product description.

The E1370A Microwave Switch / Step Attenuator Driver can drive either one of several Agilent 876XK single-pole, multi-throw dc to 26.5 GHz switches or one of several 3332XX programmable step attenuators. Depending on attenuator, 1 dB or 10 dB steps may be chosen.

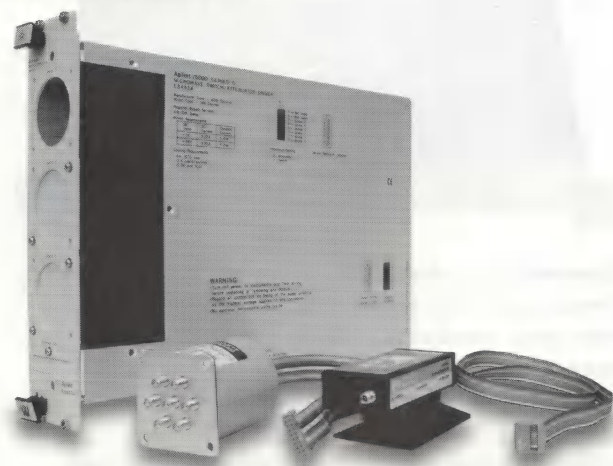
Switches, Microwave

Family Specifications

Model	E1368A 18 GHz Microwave Switch	E1369A Microwave Switch Driver	E1370A Microwave Switch/Step Attenuator Driver	E8483A Microwave Switch/Step Attenuator Driver
Description	Includes 3 Agilent 8762B 3-port microwave switches on the VXI module.	Mount up to 3 Agilent 8762/63/64 Series microwave switches on the E1369A, or control up to 5 of these switches mounted external to the E1369A. Switches not included with E1369A.	Mount 1 Agilent 8766/67/68/69K Series microwave switch or one Agilent 33320/21/22/23G/H Series attenuator on the VXI module, or control 1 of these devices mounted external to the E1370A. Switch or attenuator not included with E1370A	Mount up to 3 Agilent 87104/87106 Series microwave switches in the VXI module, or control a combination of up to 6 of these switches and/or Agilent 84904/06/07K/L Series attenuators mounted external to the E8483A. Switches and attenuators not included with E8483A.
VXI module size:	B	B	B	C
Adapter to use in C-size system:	E1403C	E1403C	E1403C Opt 001	n/a
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.				
VXIplug&play Win Framework:	Yes	No	No	No
VXIplug&play Win 95/NT Framework:	Yes	Yes	Yes	Yes
VXIplug&play HP-UX Framework:	No	No	No	No

Microwave Switch/Step Attenuator Driver

Agilent E8483A



Agilent E8483A shown with Agilent 87106 Series Switch and Agilent 84904 Series Attenuator

- 2-Slot, C-size, register based
- Controls any Agilent 87104/87106 Series microwave switch (switching up to 26.5 GHz)
- Controls any Agilent 84904/06/07K/L programmable step attenuator (programmable in 1- or 10-dB steps up to 90 dB, up to 40 GHz)

Description

The Agilent Technologies E8483A Switch/Step Attenuator Driver is a C-size, 2-slot, register-based VXI module. You can control up to six switches and/or attenuators. The module provides room for you to install up to three single-pole multithrow microwave switches in the module. Or you can mount the switches and/or attenuators external to the VXI module in a location closer to your DUT. The microwave switches and attenuators are not included with the E8483A and must be ordered separately.

The E8483A contains the control, drive, and power circuitry for controlling both microwave switches and step attenuators. Any combination of up to six devices (switches or attenuators) can be controlled by the E8483A. The module includes six 16-pin DIP sockets for connecting up to six microwave switches, and six 10-pin DIP sockets for connecting up to six step attenuators.

The E8483A provides +24 V drive signals to control the 87104/06 Series microwave switches and 84904/06/07K/L Series programmable step attenuators. Cables for connecting the E8483A to the drive circuitry of the switches and attenuators are included with the E8483A.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

For More Information

Please request the Agilent *RF & Microwave Test Accessories Catalog* for additional information, Pub No. 5968-4314.

Product Specifications

Single-Pole MultiThrow Microwave Switches*

Configuration:	
87104A/B/C:	SP4T terminated
87106A/B/C:	SP6T terminated
Connectors:	SMA
Impedance:	50 Ω
Frequency range:	dc to 26.5 GHz
Life and repeatability:	5x10E6
Power average/peak:	1 W/50 W

Programmable Step Attenuators*

Model	Frequency Range (GHz)	Atten/Steps	Insertion Loss @ 0 dB	SWR Maximum
84904K	dc to 26.5	0-11/1 dB steps	0.8 dB + 0.04 dB/GHz	1.3 to 1.8
84904L	dc to 40	0-11/1 dB steps	0.8 dB + 0.04 dB/GHz	1.3 to 1.8
84906K	dc to 26.5	0-90/10 dB steps	0.8 dB + 0.04 dB/GHz	1.3 to 1.8
84906L	dc to 40	0-90/10 dB steps	0.8 dB + 0.04 dB/GHz	1.3 to 1.8
84907K	dc to 26.5	0-70/10 dB steps	0.6 dB + 0.03 dB/GHz	1.25 to 1.7
84907L	dc to 40	0-70/10 dB steps	0.6 dB + 0.03 dB/GHz	1.25 to 1.7

* Note: For more detailed information about microwave switches and step attenuators, please refer to the *Agilent RF & Microwave Test Accessories Catalog*, Pub No. 5968-4314.

General Specifications

VXI Characteristics

VXI device type:	Register-based, A16, slave only
Size:	C
Slots:	2
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website

(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.11.01
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

Watts/slot:	15
ΔP mm H₂O:	0.08
Air flow liter/s:	1.2

Module Current

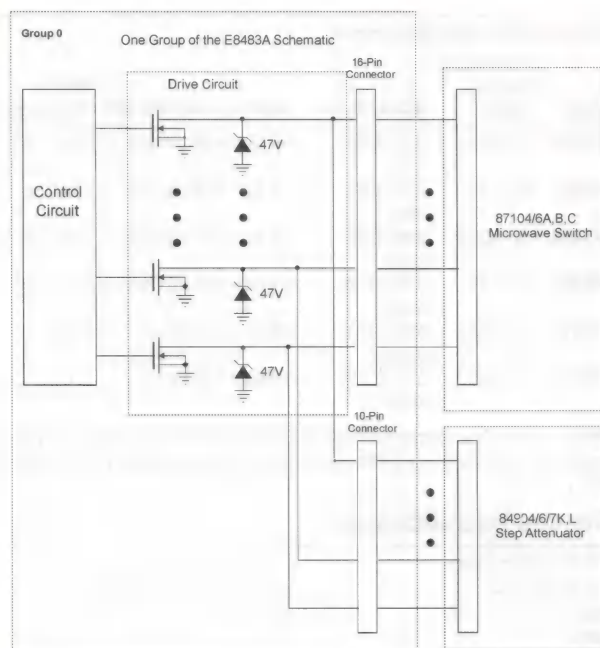
	I_{PM} (A)	I_{DM} (A)
+5 V:	0.1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	1.2	0.1
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Ordering Information

Description	Product No.
Microwave Switch/Step Attenuator Driver	E8483A*
3 yr. rtn. to Agilent to 1 yr. OnSite Warr.	E8483A W01
Microwave Switch	87104/87106 Series
Step Attenuator	84904/06/07K/L Series

* Note: The E8483A includes six ribbon cables for Agilent 87104/87106 Series switches and six ribbon cables for Agilent 84904/84906/84907K/L attenuators.

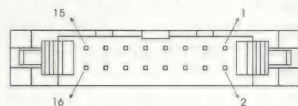
(Agilent E8483A continued)



Note: Microwave switch connections are made to the 16-pin connectors.
Attenuator connections are made to the 10-pin connectors.
However, only one connector of the same group can be used at a time.

Agilent E8483A Driver Circuit

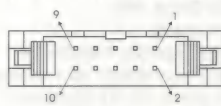
One of the Six Connectors for Microwave Switches



Pins	Function
1	+24 Vdc
2	Ind. Comm.
3	Path 1*
4	Ind. 1
5	Path 2
6	Ind. 2
7	Path 3
8	Ind. 3
9	Path 4*
10	Ind. 4
11	Path 5
12	Ind. 5
13	Path 6
14	Ind. 6
15	Common Ground
16	Open all paths

* Paths 1 and 4 not connected for 87104A,B,C

One of the Six Connectors for Attenuators



Pins	Function
1	Section 1 Thru Line
2	Section 1 Attn Card
3	Common Ground
4	Section 3 Thru Line
5	Section 2 Thru Line
6	Section 4 Thru Line*
7	Section 4 Attn Card*
8	Section 2 Attn Card
9	Section 3 Attn Card
10	+24 Vdc

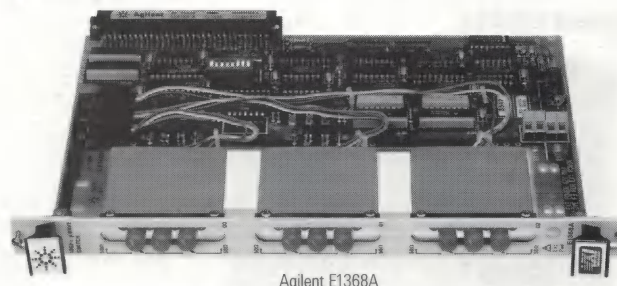
* Section 4 not connected for 84907K/L

16-Pin and 10-Pin Connectors Pinout

Publication No.: 5988-1409EN

18 GHz Microwave Switch (3 channels)

Agilent E1368A



- Signal switching from dc to 18 GHz
- Three internal SPDT 50 Ω terminated switches
- Two additional external switches allowed
- High isolation >90 dB provided
- Break-before-make operation

Description

The Agilent Technologies E1368A Microwave Switch is a **B-size, 1-slot, register-based VXI module**. This module, which incorporates the 8762B microwave switch, provides 3-channels of single-pole, double-throw coaxial switching. The three coaxial switches provided have excellent electrical characteristics for transmission systems operating from dc to 18 GHz. The module panels are numbered 00, 01, 02 to indicate the channel numbers of each coaxial switch installed.

The E1368A microwave switch module contains three factory-installed 50 Ω switches, giving it broad bandwidth, high isolation, and excellent repeatability. The switches can be easily activated from a user's program via SCPI commands. This module also comes with a 14-pin DIP socket for connecting two additional switches mounted remotely. The coaxial switches always operate in break-before-make fashion and are controlled by a latching solenoid.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Each SPDT (Form C) switch has three 3 mm SMA connectors labeled "1" (NC), "2" (NO), and "C" (Common).

These coaxial switches always operate in break-before-make fashion and are controlled by a latching solenoid. Internal coil contacts open and remove coil voltage after a switching operation to minimize the amount of heat dissipated near the switch. When a coil is energized and a switching operation occurs, a pivot armature in the microwave switch also operates both sets of contacts, either closing the switch or connecting it to the 50 Ω termination, so that a 50 Ω match is always maintained.

Product Specifications

Frequency:	dc to 18 GHz
Ports:	3
Internal termination:	Terminated
Insertion loss (dB):	<0.20 to 2 GHz <0.25 to 4 GHz <0.50 to 18 GHz
SWR (into termination or through line):	<1.1 to 2 GHz <1.2 to 4 GHz <1.3 to 18 GHz
Isolation (dB):	>90 to 18 GHz
Life and repeatability (typical):	10 ⁶ cycles, 0.03 dB
Power (peak power is nonswitching):	1 Watt average 100 Watts peak (+ 7 Vdc)
Switching speed:	30 ms
RF connectors:	SMA (female)
Switching dwell time:	35 ms
Driver output voltage:	5 V or 12 V

Control circuit can switch max 1 A per switch. Max current also depends on output capability of the mainframe.

Maximum external energizing voltage: 30 V

(Agilent E1368A continued)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	1.3	0.01
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

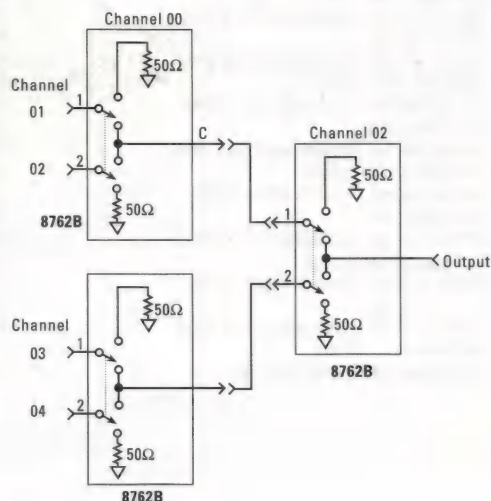
Cooling/Slot

Watts/slot:	5.00
ΔP mm H ₂ O:	0.08
Air Flow liter/s:	0.42

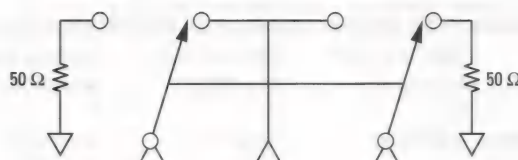
Ordering Information

Description	Product No.
18 GHz Microwave Switch (3 channels)	E1368A
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1368A W01
Drive Cable, 40GHz Attn 14pin DIP 16in	11764D

4x1 MW Switch



4 x 1 Microwave Switch Example

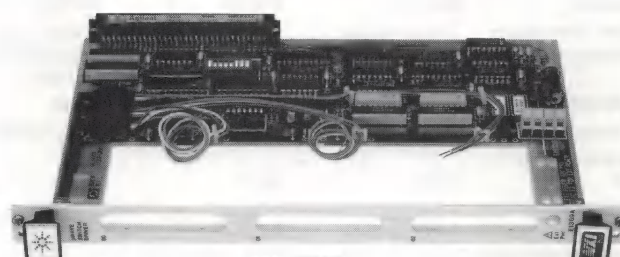


Agilent E1368A/E1369A/E1370A Drive Circuits

Publication No.: 5965-5596E

Microwave Switch Driver

Agilent E1369A



Agilent E1369A

- 1-Slot, B-size, register based
- Signal switching from dc to 26.5 GHz
- Drive three internal 50 Ω terminated switches
- Drive two additional external switches
- Select internal or use external energizing voltages
- Use equivalent switches of other manufacturers

Description

The Agilent Technologies E1369A Microwave Switch Driver is a B-size, 1-slot, register-based VXI module. It provides room for you to install up to three 8762B/C, 8763B/C, and 8764B/C (3-port, 4-port, and 5-port) series of microwave switches to match your application needs up to 25.6 GHz. These switches must be ordered separately.

The E1369A can power and control a total of five switches, two of which must be mounted externally with ribbon cable and DIN connector. Additionally, you can select internal energizing voltages +5 and +12 Vdc, or supply your own external energizing voltage up to 42 volts if more power is needed.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Other Manufacturers

These manufacturers supply equivalent switches that can be installed in the E1369A:

K&L Microwave Inc.
Dynatech Microwave Tech Inc.
RLC Electronics Inc.

Switches can be used if they require less than 42 V, draw less than 1 A per switch, and are of the split-coil (separate for each contact) design. Maximum current also depends on the mainframe or external supply capacity.

The following coaxial switch series will not function in the E1369A microwave switch module, because the switch coils are not split: Agilent 8761, 8766, 8767, 8768, and 8769.

(Agilent E1369A continued)

Product Specifications

Microwave Switches (+ 5 V, 50 Ω) for mounting in the E1368/69A Microwave Switch Modules

Switch:	33311B or 8762B	33311C or 8762C	33312B or 8763B	33312C or 8763C	33313B or 8764B	33313C or 8764C
Frequency:	dc to 18 GHz	dc to 26.5 GHz	dc to 18 GHz	dc to 26.5 GHz	dc to 18 GHz	dc to 26.5 GHz
Ports:	3	3	4	4	5	5
Internal termination:	Terminated	Terminated	Terminated (one port)	Terminated (one port)	Unterminated	Unterminated
Insertion loss (dB):	<0.20 to 2 GHz <0.25 to 4 GHz <0.50 to 18 GHz	<0.20 to 2 GHz <0.50 to 18 GHz <1.25 to 26.5 GHz	<0.20 to 2 GHz <0.50 to 18 GHz	<0.20 to 2 GHz <0.50 to 18 GHz	<0.20 to 2 GHz <0.50 to 18 GHz <1.25 to 26.5 GHz	<0.20 to 2 GHz <0.50 to 18 GHz <1.25 to 26.5 GHz
SWR (into termination or through line):	<1.1 to 2 GHz <1.2 to 4 GHz <1.3 to 18 GHz	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.40 to 18 GHz <1.8 to 26.5 GHz	<1.1 to 2 GHz <1.2 to 4 GHz <1.3 to 18 GHz	<1.15 to 2 GHz <1.25 to 12.4 GHz <1.40 to 18 GHz <1.8 to 26.5 GHz	Into Termination: n/a Through Line: same as Agilent 8763B	Into Termination: n/a Through Line: same as Agilent 8763C
Isolation (dB):	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz	>90 to 18 GHz	>90 to 18 GHz >50 to 26.5 GHz
Life and repeatability (typical):	10 ⁶ cycles 0.03 dB	10 ⁶ cycles 0.03 dB	10 ⁶ cycles 0.03 dB	10 ⁶ cycles 0.03 dB	10 ⁶ cycles 0.03 dB	10 ⁶ cycles 0.03 dB
Power (peak power is nonswitching):	1 Watt average 100 Watts peak (+ 7 Vdc)	1 Watt average 100 Watts peak (+ 7 Vdc)	1 Watt average 100 Watts peak (+ 7 Vdc)	1 Watt average 100 Watts peak (+ 7 Vdc)	1 Watt average 100 Watts peak (+ 7 Vdc)	1 Watt average 100 Watts peak (+ 7 Vdc)
Switching speed:	30 ms	30 ms	30 ms	30 ms	30 ms	30 ms
RF connectors:	SMA (female)	3.5 mm (female)	SMA (female)	3.5 mm (female)	SMA (female)	3.5 mm (female)
Switching dwell time:	35 ms	35 ms	35 ms	35 ms	35 ms	35 ms
Driver output voltage (1 A max per switch):	5 V or 12 V	5 V or 12 V	5 V or 12 V	5 V or 12 V	5 V or 12 V	5 V or 12 V
Maximum external energizing voltage:	42 V	42 V	42 V	42 V	42 V	42 V

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.1	0
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

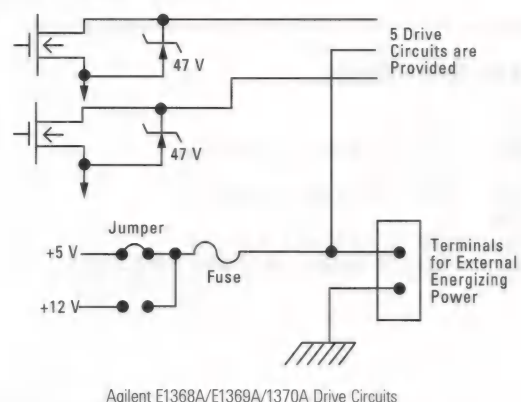
Cooling/Slot

Watts/slot:	5.00
ΔP mm H₂O:	0.08
Air Flow liter/s:	0.50

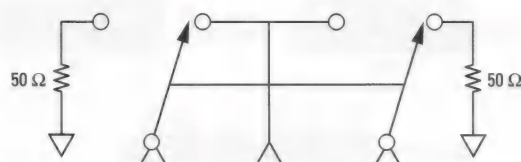
Ordering Information

Description	Product No.
Microwave Switch Driver	E1369A
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1369A W01
Coaxial SPDT Switch, dc-18 GHz	8762B
5 V Solenoids Instead of 24 V Solenoids	8762B 011
Commercial Cal. Certificate w/Test Data	8762B UK6
Certificate of Calibration	8762B UKS
Coaxial SPDT Switch, dc-26.5 GHz; 50 Ω	8762C
5 V Solenoids Instead of 24 V Solenoids	8762C 011
Commercial Cal. Certificate w/Test Data	8762C UK6
Certificate of Calibration	8762C UKS
Switch, Coaxial, Transfer Switch, 4 Port	8763B
5 Volt Solenoids	8763B 011
Commercial Cal. Certificate w/Test Data	8763B UK6
Certificate of Calibration	8763B UKS
Switch, Coaxial, Transfer Switch, 4 Port	8763C
5 Volt Solenoids	8763C 011
Commercial Cal. Certificate w/Test Data	8763C UK6
Certificate of Calibration	8763C UKS
Switch, Coaxial, Signal Reversal, 5 Port	8764B
5 Volt Solenoids	8764B 011
Commercial Cal. Certificate w/Test Data	8764B UK6
Certificate of Calibration	8764B UKS
Switch, Coaxial, Signal Reversal, 5 Port	8764C
5 Volt Solenoids	8764C 011
Commercial Cal. Certificate w/Test Data	8764C UK6
Certificate of Calibration	8764C UKS
Drive Cable, 40GHz Attn 14pin DIP 16in	11764D

(Agilent E1369A continued)



Agilent E1368A/E1369A/1370A Drive Circuits

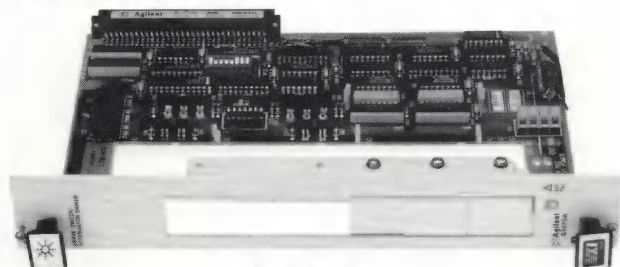


Agilent E1369A Switch Configurations

Publication No.: 5965-5597E

Microwave Switch/Step Attenuator Driver

Agilent E1370A



Agilent E1370A

- 2-Slot, B-size, register based
- Switching and attenuation up to 26.5 GHz
- Drive any Agilent 8766K/67K/68K/69K microwave switch
- Drive any Agilent 3332XG prog. step attenuator
- Programmable 1 or 10 dB steps up to 110 dB
- Select internal or use external energizing power

Description

The Agilent Technologies E1370A Switch/Step Attenuator Driver is a B-size, 2-slot, register-based VXI module. It provides room for you to install one single-pole multithrow microwave switch or a programmable step attenuator.

The 8766K/8767K/8768K/8769K single-pole, multithrow switches can be installed, providing 3-, 4-, 5-, or 6-throw switching. Alternatively, the 33320G/H, 33321G/H, 33322G/H, and 33323K step attenuators can be installed providing broadband accuracy, high repeatability over a long life, and rapid switching flexibility. Whichever device you choose, you must order each one separately.

This module contains the control, drive, and power circuitry for mounting and controlling the microwave switches or step attenuators. It comes with a 14-pin DIP socket for connecting one microwave switch or step attenuator either in the module or remotely.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Documentation Available

Please request the Agilent *RF & Microwave Test Accessories Catalog* for additional information, Pub. No 5968-4314

Cabling

For frequencies up to 18 GHz, use a good quality flexible cable and SMA connectors. For frequencies above 18 GHz, use semi-rigid type cable and APC 3.5 connectors.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	2
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.1	0
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	5.00
ΔP mm H₂O:	0.08
Air Flow liter/s:	0.50

Product Specifications

Single-Pole MultiThrow Microwave Switches

Configuration:	8766K: SP3T unterminated 8767K: SP4T unterminated 8768K: SP5T unterminated 8769K: SP6T unterminated
Connectors:	APC-3.5 (SMA compatible) all switches. (Opt 002 deletes APC and adds SMA.)
Impedance:	50 Ω
Frequency range:	dc-26.5 GHz
Life and repeatability:	0.03 dB @ 10 ⁶ cycles per section
Power average/peak:	1 W avg, 100 W peak (+ 7 Vdc) (nonswitching) 0.03 dB max (typically 0.01 dB over 5 million switching cycles per section)
Repeatability:	
Max RF power:	1 W avg, 100 W peak (10 μ s)

(Agilent E1370A continued)

Programmable Step Attenuators

Model	Frequency Range (GHz)	Atten / Steps	Insertion Loss @ 0 dB	SWR Maximum
33320G	dc - 4	0-11 / 1 dB steps	0.6 dB + 0.09 dB/GHz	4 GHz: 1.5
33320H	dc - 18	0-11 / 1 dB steps	0.6 dB + 0.09 dB/GHz	8 GHz: 1.5 12.4 GHz: 1.6 18 GHz: 1.9
33321G	dc - 4	0-70 / 10 dB steps	0.4 dB + 0.07 dB/GHz	4 GHz: 1.35
33321H	dc - 18	0-70 / 10 dB steps	0.4 dB + 0.07 dB/GHz	8 GHz: 1.35 12.4 GHz: 1.5 18 GHz: 1.7
33322G	dc - 4	0-110 / 10 dB steps	0.6 dB + 0.09 dB/GHz	
33322H	dc - 18	0-110 / 10 dB steps	0.6 dB + 0.09 dB/GHz	8 GHz: 1.5 12.4 GHz: 1.6 18 GHz: 1.9
33323K	dc - 26.5	0-90 / 10 dB steps	0.6 dB + 0.09 dB/GHz	6 GHz: 1.25 12.4 GHz: 1.45 18 GHz: 1.6 26.5 GHz: 1.8

Note: SMA female connectors standard on all attenuators. See ordering information for other connectors.

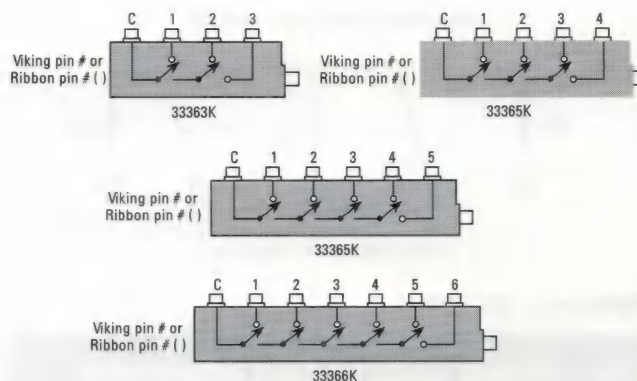
Ordering Information

Description	Product No.
Microwave Switch/Step Attenuator Driver	E1370A
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1370A W01
Programmable step attenuator, dc - 4 GHz	33320G*
Programmable step attenuator, dc - 4 GHz	33320H*
Programmable Step Attenuator	33321G*
Programmable Step Attenuator	33321H*
Programmable Step Attenuator	33322G*
Programmable Step Attenuator; 110 dB Max	33322H*
Programmable Step Attenuator	33323K*

***Note:** Order all of the above attenuators with Option 011 (5 V solenoid) and Option 008 (8-inch cable) for mounting on the E1370A, or order Option 016 (16-inch cable) for external mounting.
Other options available are:
Option 020 (233 mm long ribbon cable assembly)
Option 890 (attenuator calibration data)
Option UKS (certificate of calibration)

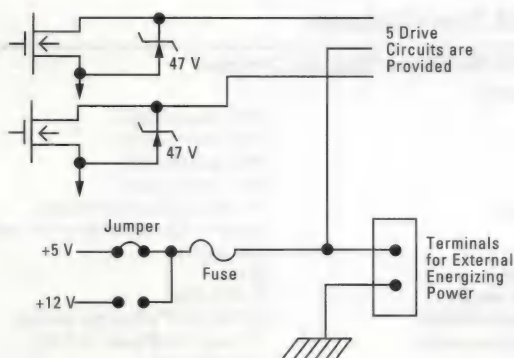
Description	Product No.
SP3T Multi-Port Switch	8766K**
SP4T Multi-Port Switch	8767K**
SP5T Multi-Port Switch	8768K**
SP6T Multi-Port Switch	8769K**

****Note:** Other options available are:
Option 002 (replaces 3.5 mm (f) with SMA (m) connectors)
Option 008 (8-inch ribbon cable with DIP connector)
Option 011 (5 Vdc supply voltages)
Option 015 (15 Vdc supply voltages)
Option 016 (16-inch ribbon cable with DIP connector)
Option UK6 (commercial calibration test data with certificate)
Option UKS (commercial calibration certificate)



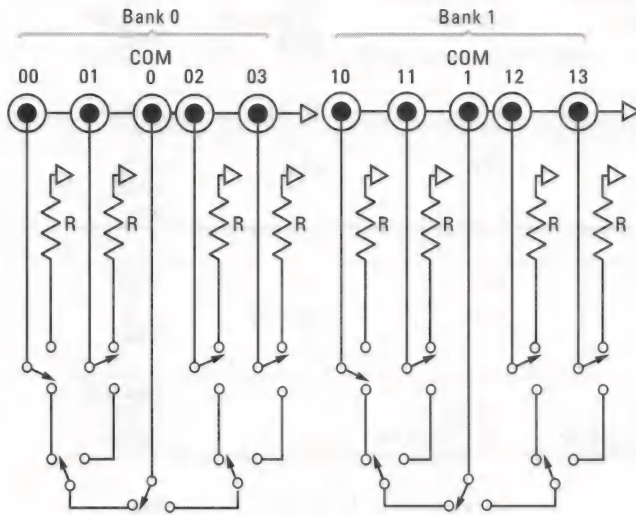
Single-Pole Multithrow Microwave Switching

Publication No.: 5965-5598E



Agilent E1368A/E1369A/E1370A Drive Circuits

Agilent E1366A — Circuit Diagram

**B-Size RF Multiplexer Switches**

Product No.	Description
E1366A	Dual 1x4, 50 Ω RF Multiplexer
E1367A	Dual 1x4, 75 Ω RF Multiplexer

C-Size RF Multiplexer Switches

Product No.	Description
E8482A	Six 1x4, 50 Ω , 3 GHz RF Multiplexer
E1470A	60-Channel RF Cascade Multiplexer
E1472A	Six 1x4, 50 Ω RF Multiplexer
E1473A	Six 1x4, 50 Ω RF Multiplexer Expander
E1474A	Six 1x4, 75 Ω RF Multiplexer
E1475A	Six 1x4, 75 Ω RF Multiplexer Expander

Introduction

The design of RF multiplexers requires the use of independent banks of switches to reduce bandlimiting capacitance. Agilent Technologies' RF multiplexers typically are designed with one or more banks of four channels that can switch signals up to 3 GHz. The user can connect banks together to achieve larger multiplexing configurations, but with increased size, bandwidth performance is reduced. Agilent RF multiplexers are designed to ensure that signal loss and noise are minimized and proper impedance matching is achieved to limit return loss.

RF multiplexers are typically used for switching signals when testing video, telecommunications, and RF related products.

The Family Specifications table in this section provides comparative information for each of the Agilent VXIbus RF Multiplexers.

Overview: RF Multiplexer Choices

For switching signals to or from your signal analyzer, signal source, or other RF equipment, Agilent offers a range of multiplexers. The E8482A provides either three or six banks of high-bandwidth 3 GHz 1x4 multiplexers. The E1472A and E1474A multiplexers offer switching solutions for 50 Ω and 75 Ω systems up to 1.3 GHz, each containing six 1x4 switch banks. These multiplexer systems can be expanded with the E1473A or E1475A switches, which can be remotely mounted near your DUT. For applications requiring a smaller number of channels, the B-size E1366A and E1367A multiplexers offer two 1x4 multiplexer banks for 50 Ω and 75 Ω systems. The E1470A provides twenty 1x3 multiplexer banks for switching signals up to 500 MHz. The E1470A allows you to easily create custom switch topologies by connecting and cascading the 1x3 switch banks.

Family Specifications

Model	E1366A	E1367A	E1472A/E1473A	E1474A/E1475A	E1470A	E8482A
	Dual 1x4, 50 Ω RF MUX	Dual 1x4, 75 Ω RF MUX	Six 1x4, 50 Ω RF MUX/MUX Expander	Six 1x4, 75 Ω RF MUX/MUX Expander	60-Channel, 50 Ω RF Cascade MUX	Six 1x4, 50 Ω , 3 GHz RF MUX
Specifications						
Channels:	2 1x4	2 1x4	6 1x4	6 1x4	20 1x3	6 1x4 or 3 1x4
Maximum voltage input⁽¹⁾:	42 V	42 V	42 V	42 V	30 V	30 Vdc, 30 Vac peak
dc						
Maximum thermal offset:	6 μ V	6 μ V	6 μ V	6 μ V	n/a	10 μ V
Closed channel resistance (typical):	<1 Ω initial <3 Ω end of relay life	<1 Ω	<1 Ω	<1 Ω	1.5 Ω typ.	<1 Ω initial
Insulation resistance (between any two terminals):	>10E8 Ω $\leq 40^\circ$ C, $\leq 65\%$ RH	>10E8 Ω $\leq 40^\circ$ C, $\leq 65\%$ RH	>10E8 Ω $\leq 40^\circ$ C, $\leq 65\%$ RH	>10E8 Ω $\leq 40^\circ$ C, $\leq 65\%$ RH	n/a	10E6 Ω @ $\leq 40^\circ$ C, 65% RH
ac						
Characteristic impedance (Z_0):	50 Ω	75 Ω	50 Ω	75 Ω	50 Ω	50 Ω
Insertion loss:						
<10 MHz:	<0.3 dB	<0.3 dB	<0.1 dB	<0.3 dB	<0.25 typ.	n/a
<100 MHz:	<0.7 dB	<0.7 dB	<0.4 dB	<0.4 dB	<0.6 typ.	n/a
<500 MHz:	<1.5 dB	<1.5 dB	<0.9 dB	<0.8 dB	<3 dB (3:1)	<0.5 dB
<1.3 GHz:	<3.0 dB	<3.0 dB	<1.5 dB	<1.0 dB	n/a	<1.0 dB
<3 GHz (typ):	n/a	n/a	<8.0 dB	n/a	n/a	<2.0 dB
Crosstalk (channel-to-channel)⁽²⁾:						
<10 MHz:	<-90 dB	<-90 dB	<-90 dB	<-85 dB	<-80 dB	n/a
<100 MHz:	<-80 dB	<-80 dB	<-80 dB	<-75 dB	<-60 dB	n/a
Crosstalk (channel-to-channel)⁽³⁾:						
<200 MHz:	n/a	n/a	n/a	n/a	<-50 dB	n/a
<500 MHz:	<-60 dB	<-60 dB	<-62 dB	<-60 dB	<-40 dB	<-60 dB
<1.3 GHz:	<-40 dB	<-40 dB	<-50 dB	<-42 dB	n/a	<-55 dB
VSWR:						
<10 MHz:	<1.2	<1.2	<1.05	<1.05	n/a	n/a
<100 MHz:	<1.25	<1.25	<1.15	<1.15	(3:1) <1.4	n/a
<200 MHz:	n/a	n/a	n/a	n/a	(3:1) <1.45	n/a
<500 MHz:	<1.35	<1.35	<1.35	<1.35	(3:1) <1.7	<1.15
<1.3 GHz:	<1.55	<1.55	<1.5	<1.5	n/a	<1.35
Risetime:	<300 ps	<300 ps	<300 ps	<300 ps	n/a	<300 ps
Signal delay:	<3 ns	<3 ns	<3 ns	<3 ns	n/a	<3 ns
Center-shield capacitance:	<60 pF	<60 pF	n/a	n/a	n/a	n/a
Chassis-shield capacitance:	<0.15 μ F	<0.15 μ F	n/a	n/a	n/a	n/a
VXI Characteristics						
Size:	B	B	C	C	C	C
Slots:	1	1	1	1	1	1
VXI device type:	Register based	Register based	Register based	Register based	Register based	Register based

Note: ac specs apply only if switch $Z_0 = Z_{\text{source}} = Z_{\text{load}}$; RH $\leq 95\%$ E1472A/73/74/75A; RH $\leq 65\%$ E1366A, E1367A.

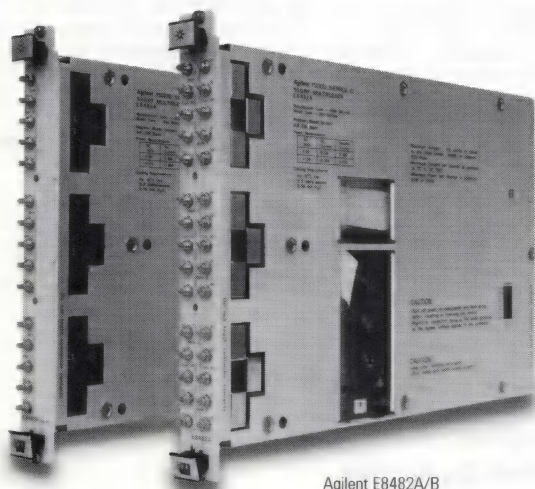
⁽¹⁾ Center or shield-to-center, shield or chassis.

⁽²⁾ E1366A, E1367A: If all channels are unterminated, derate crosstalk specifications by 6 dB.

⁽³⁾ E1366A, E1367A: If all channels are unterminated, derate crosstalk specifications by 6 dB. Measurements are made from one channel closed or channel-to-common (terminated).

Six 1x4 and Three 1x4, 50 Ω , 3 GHz RF Multiplexers

Agilent E8482A, E8482B



Agilent E8482A/B

- Six or three 1x4 multiplexers
- Switch signals up to 3 GHz
- Tree switching for high isolation, low VSWR
- SMB male connectors for high performance
- Compatible with E1472A
- Controls E1473A/E1475A RF expanders

Description

The Agilent Technologies E8482A and E8482B 50 Ω , 3 GHz RF Multiplexers are C-size, 1-slot, register-based VXI modules. They are the ideal choice for your test system (oscilloscope or spectrum, network or distortion analyzer, or other RF equipment). These modules can have either six (E8482A) or three (E8482B) multiplexers.

The E8482A and E8482B can easily be programmed with SCPI commands to scan multiple channels, where each channel is switched to its common, one at a time. These modules are arranged as either six or three independent banks of channels (Bank 0 through Bank 5), each acting as a 1x4 one-wire multiplexer. Only one channel in each bank can be connected to its common at any time. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR. The E8482A and E8482B can also control E1473A or E1475A 1.3 GHz RF multiplexers.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Product Specifications

Input

Maximum voltage input:	30 Vdc, 30 Vac peak
Maximum current (per channel or common):	
dc:	0.5 A
Maximum power (per channel or common):	
dc:	10 W
ac:	10 VA

dc

Maximum thermal offset:	10 μ V
Closed channel resistance (initial):	<1 Ω
Insulation resistance (between any two terminals):	10E6 Ω at $\leq 40^\circ$ C, 65% RH

ac

Characteristic impedance (Z_0):

Insertion loss:

<500 MHz:	<0.5 dB
<1 GHz:	<0.6 dB
<2 GHz:	<1.0 dB
<2.5 GHz:	<1.5 dB
<3 GHz:	<2.0 dB (typical)

Crosstalk (channel-to-channel):

<500 MHz:	<-60 dB
<1 GHz:	<-57 dB
<2 GHz:	<-55 dB
<2.5 GHz:	<-40 dB
<3 GHz:	<-39 dB (typical)

VSWR:

<500 MHz:	<1.15
<1 GHz:	<1.25
<2 GHz:	<1.35
<2.5 GHz:	<1.45
<3 GHz:	<1.50 (typical)

Risetime:

<300 ps

Signal delay:

<3 ns

General

Typical relay life (number of operations):

Rated load*:	10E5
Relay type:	Non-latching armature

*10 mA Vdc; 2.5GHz; impedance 50 Ω

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, Slave only
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.11.01
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Cooling/Slot

Watts/slot:	6
ΔP mm H ₂ O:	0.1
Air flow liter/s:	0.5

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	0.10	0.10
+12 V:	0.21	0.10
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

(Agilent E8482A, E8482B continued)

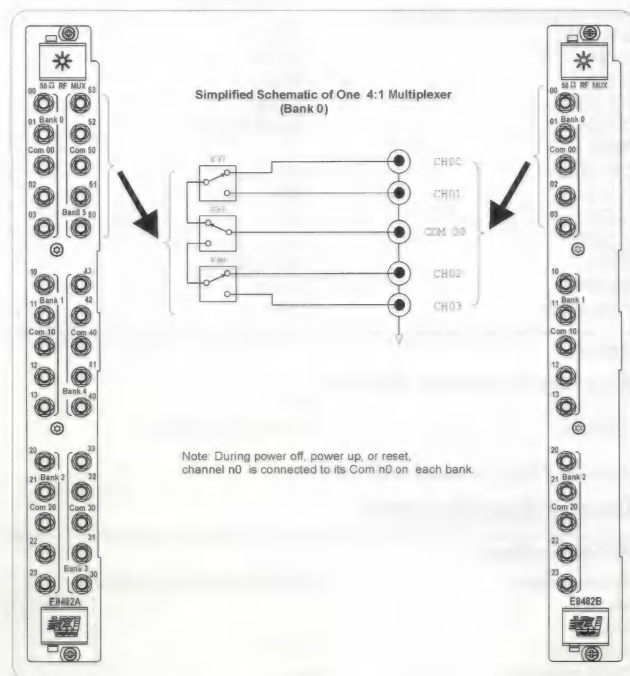
Ordering Information

Description

Six 1x4, 50 Ω 3 GHz RF Multiplexer
 3 yr. Retn. to Agilent to 1 yr. OnSite warr.
 Three 1x4, 50 Ω , 3GHz RF Multiplexer
 3 yr. Retn. to Agilent to 1 yr. OnSite warr.

Product No.

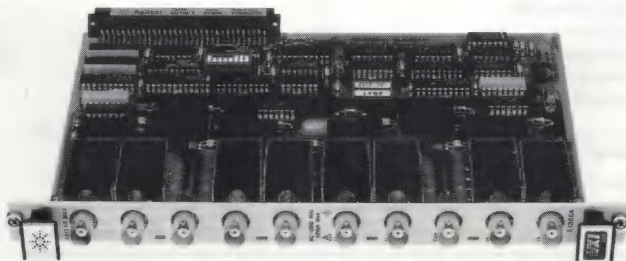
E8482A
 E8482A W01
 E8482B
 E8482B W01



Publication No.: 5988-1407EN

Dual 1x4, 50 Ω RF Multiplexer

Agilent E1366A



Agilent E1366A

- 1-Slot, B-size, register based
- Two 1x4 multiplexers
- Up to 1.3 GHz signals switched
- BNC connectors
- Off-channels terminated
- Low insertion loss

Description

The Agilent Technologies E1366A 50 Ω RF Multiplexer is a **B-size, 1-slot, register-based VXI module**. It is the ideal choice to switch test signals to your oscilloscope and spectrum, network, distortion analyzers, or other RF equipment. The E1366A is identical to the E1367A, except that the E1367A has a 75 Ω characteristic impedance.

Switching consists of connecting a channel to its common terminal. The E1366A can easily be used with SCPI commands to scan multiple channels, where each channel is switched to its common, one at a time. When open (disconnected from common), each channel is connected to a 50 Ω termination.

This multiplexer module is arranged as two independent banks of channels (Bank 0 and Bank 1), each acting as a 1x4 one-wire multiplexer. Only one channel in each bank can be connected to its common at any time. Each channel consists of a nonlatching armature relay. At power-on or reset, all channels are open and connected to their termination resistors. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Cables and Connectors

Various 50 Ω cables are available from Agilent for connecting to the BNC connectors on the front panel of the multiplexer. Adapters and other connectors are also available.

C-size Adapter

For installing the E1366A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis):	42 V
Maximum current (per channel or common):	
dc:	1 A
ac rms:	1 A
Maximum power (per channel or common):	
dc:	24 W
ac:	24 VA

dc

Maximum thermal offset:	6 μ V
Closed channel resistance (typical):	<1 Ω initial, <3 Ω end of relay life
Insulation resistance (between any two points):	>10E8 Ω \leq 40° C, \leq 65% RH

(Agilent E1366A continued)

ac

Note: For ac performance, $Z_L=Z_S=Z_0$, $\leq 40^\circ\text{C}$, RH $\leq 95\%$ for C-size, RH $\leq 65\%$ for B-size.

Characteristic impedance (Z_0): 50 Ω

Insertion loss:
 <10 MHz: <0.3 dB
 <100 MHz: <0.7 dB
 <500 MHz: <1.5 dB
 <1.3 GHz: <3.0 dB
 <3 GHz (typ): n/a

Crosstalk (channel-to-channel):

Derate crosstalk specifications by 6 dB if all channels are unterminated.

<10 MHz: <-90 dB
 <100 MHz: <-80 dB

Crosstalk (channel-to-channel, one channel closed or channel-to-common) (terminated):

Derate crosstalk specifications by 6 dB if all channels are unterminated.

<200 MHz: n/a
 <500 MHz: <-60 dB
 <1.3 GHz: <-40 dB
 <3 GHz (typ): n/a

VSWR:

<10 MHz: <1.2
 <100 MHz: <1.25
 <200 MHz: n/a
 <500 MHz: <1.35
 <1.3 GHz: <1.55
 <3 GHz: n/a

Risetime:

<300 ps

Signal delay:

<3 ns

Capacitance:

Center-shield: <60 pF

Chassis-shield: <0.15 μF

General Characteristics

Relays: Non-latching armature
Power up/down state: All open
Minimum relay life:
 No load: 5x10E6 operations
 Rated load: 10E5 operations

General Specifications**VXI Characteristics**

VXI device type: Register based, A16, slave only
Size: B
Slots: 1
Connectors: P1
Shared memory: None
VXI buses: None
C-size compatibility: Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable
Command module firmware rev: A.01
I-SCPI Win 3.1: Yes
I-SCPI Series 700: Yes
C-SCPI LynxOS: Yes
C-SCPI Series 700: Yes
Panel Drivers: Yes
VXIplug&play Win Framework: No
VXIplug&play Win95/NT Framework: No
VXIplug&play HP-UX Framework: No

Module Current

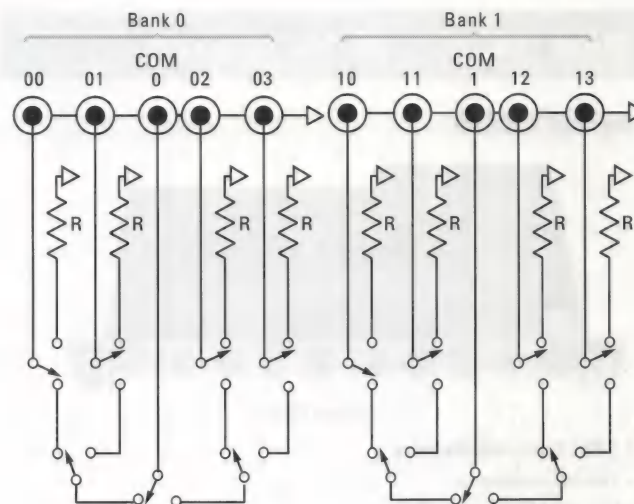
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.18	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

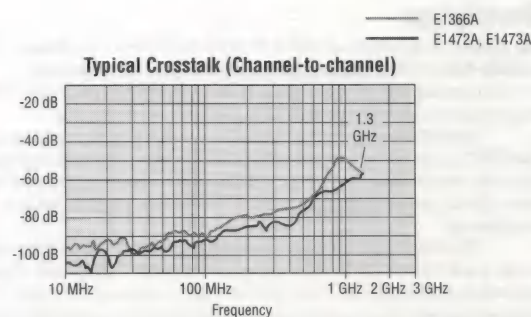
Watts/slot:	3.00
ΔP mm H ₂ O:	0.05
Air Flow liter/s:	0.25

Ordering Information

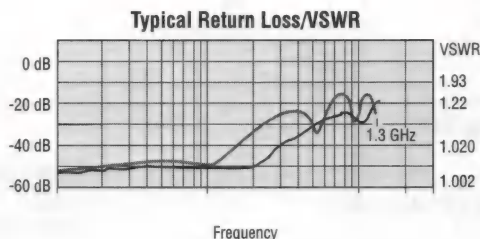
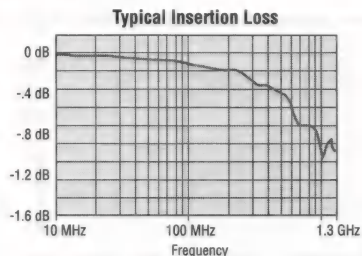
Description	Product No.
Dual 1x4, 50 Ω RF Multiplexer	E1366A
Service Manual	E1366A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1366A W01



Agilent E1366A Circuit Diagram



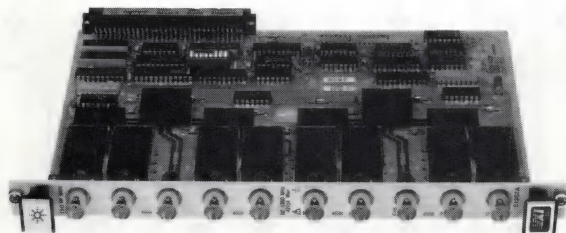
(Agilent E1366A continued)



Publication No.: 5965-5608E

Dual 1x4, 75 Ω RF Multiplexer

Agilent E1367A



Agilent E1367A

- 1-Slot, B-size, register based
- Two 1x4 multiplexers
- Up to 1.3 GHz signals switched
- BNC connectors
- Off-channels terminated
- Tree-switched configuration provides high isolation

Description

The Agilent Technologies E1367A 75 Ω RF Multiplexer is a B-size, I-slot, register-based VXI module. It is the ideal choice for video and telecommunications applications. The E1367A is identical to the E1366A, except that the E1366A has a 50 Ω characteristic impedance.

Switching consists of connecting a channel to its common terminal. The E1367A can easily be used with SCPI commands to scan multiple channels, where each channel is switched to its common, one at a time. When open (disconnected from common), each channel is connected to a 75 Ω termination.

The E1367A is arranged as two independent banks of channels (Bank 0 and Bank 1), each acting as a 1x4 one-wire multiplexer. Only one channel in each bank can be connected to its common at any time. Each channel consists of a nonlatching, armature relay. At power-on or reset, all channels are open and connected to their termination resistors. The termination resistor can be removed if desired. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Cables and Connectors

Various 75 Ω cables are available from Agilent for connecting to the BNC connectors on the front panel of the multiplexer. Adapters and other connectors are also available.

C-size Adapter

For installing the E1367A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis):	42 V
Maximum current (per channel or common):	
dc:	1 A
ac rms:	1 A
Maximum power (per channel or common):	
dc:	24 W
ac:	24 VA

dc

Maximum thermal offset:	6 μ V
Closed channel resistance (typical):	<1 Ω initial, <3 Ω end of relay life
Insulation resistance (between any two terminals):	>10E8 Ω \leq 40°C, \leq 65% RH

ac

Note: For ac performance, ZL=ZS=Z0, \leq 40° C, RH \leq 95% for C-size, RH \leq 65% for B-size.

Characteristic impedance (Z0): 75 Ω

Insertion loss:

<10 MHz:	<0.3 dB
<100 MHz:	<0.7 dB
<500 MHz:	<1.5 dB
<1.3 GHz:	<3.0 dB
<3 GHz (typ):	n/a

Crosstalk (channel-to-channel):

Derate crosstalk specifications by 6 dB if all channels are unterminated.

<10 MHz:	<-90 dB
<100 MHz:	<-80 dB

Crosstalk(1) (channel-to-channel, one channel closed or channel-to-common) (terminated):

<200 MHz:	n/a
<500 MHz:	<-60 dB
<1.3 GHz:	<-40 dB
<3 GHz (typ):	n/a

VSWR:

<10 MHz:	<1.2
<100 MHz:	<1.25
<200 MHz:	n/a
<500 MHz:	<1.35
<1.3 GHz:	<1.55
<3 GHz:	n/a

Risetime:

<300 ps

Signal delay:

Center-shield:	<60 pF
Chassis-shield:	<0.15 μ F

General Characteristics

Relays:	Non-latching armature
Power up/down state:	All open
Minimum relay life:	
No load:	5x10E6 operations
Rated load:	10E5 operations

(Agilent E1367A continued)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Module Current

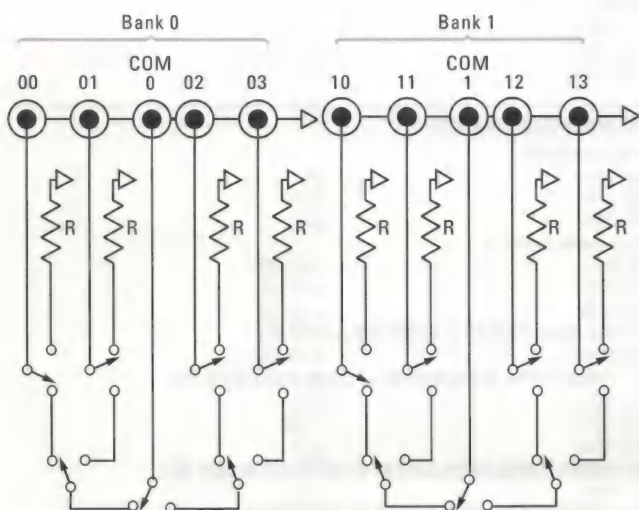
	I_{PM}	I_{DM}
+5 V:	0.1	0.01
+12 V:	0.18	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	3.00
ΔP mm H ₂ O:	0.05
Air Flow liter/s:	0.25

Ordering Information

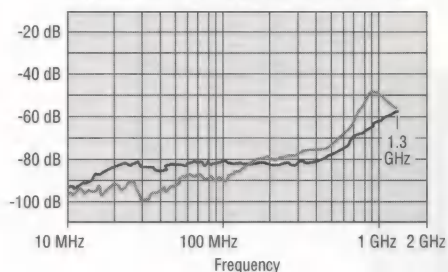
Description	Product No.
Dual 1x4, 75 Ω RF Multiplexer	E1367A
Service Manual	E1367A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1367A W01



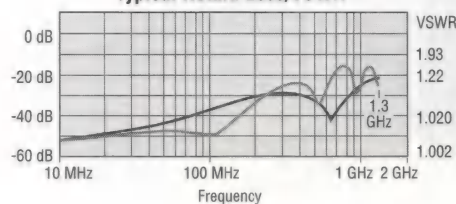
Agilent E1367A-Circuit Diagram

— E1367A
— E1474A, E1475A

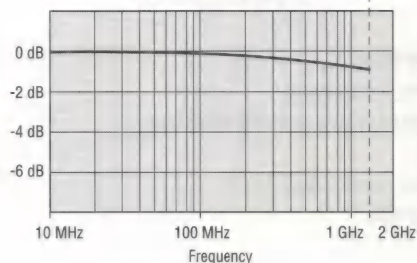
Typical Crosstalk (Channel-to-channel)



Typical Return Loss/VSWR



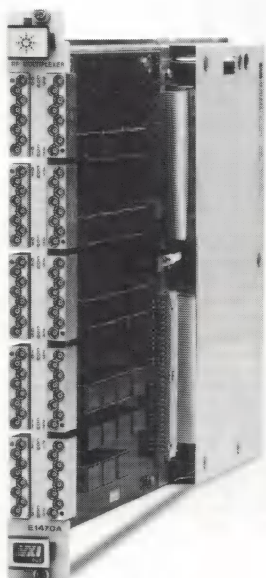
Typical Insertion Loss

75 Ω Mux Typical AC Performance Graphs

Publication No.: 5965-5609E

60-Channel 50 Ω RF Cascade Multiplexer

Agilent E1470A



Agilent E1470A

- 1-Slot, C-size, register based
- Twenty 3:1 multiplexer configurations
- 3:1, 6:1, 9:1—up to 60:1 by cascading twenty multiplexers
- 500 MHz bandwidth
- Simultaneous multiple cascade combinations
- Isolation 50 dB at 200 MHz

Description

The Agilent Technologies E1470A 50 Ω RF Multiplexer is a C-size, 1-slot, register-based VXI module. It is a high density multiplexer featuring twenty 3:1 multiplexers for maximum design flexibility. The twenty 3:1 multiplexers can be arranged in a cascade configuration to form a single 60-channel RF multiplexer, or they can be configured into multiple sets of cascade multiplexers.

The E1470A provides a reliable, high quality means of switching your RF system. High isolation is maintained over a wide bandwidth. The twenty independent 3:1 multiplexers can be configured to other multiplexer sizes by specifying a valid path from a COM to a channel in a different bank. Various sizes of multiplexers can be configured from a single E1470A module.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Programming

Commands with register reads/writes, making programming and system configuration easy. For example, you can use SCPI commands to specify a source channel, as well as a destination or common connection i.e., PATH 01, 002 (SCPI). Switching is then done automatically.

Configuration

The twenty independent 3:1 multiplexers can be configured to other multiplexer sizes by specifying a valid path from a COM to a channel in a different bank. Various sizes of multiplexers can be configured from a single E1470A module.

For example, a 6:1 multiplexer can be formed using COM 01 as the common for channels 000–002 and 010–012. A second 6:1 multiplexer can be configured using COM 11 for channels 100–102 and 110–112.

Cable and Connectors

Each module is shipped with kit Agilent E1470-80003 containing ten cable housing assemblies (P/N 1250-2563) and 80 cable jacks. You must use male jacks (P/N E1470-22101) in the supplied connector housing (P/N 1250-2563). These male jacks allow you to use all the connector sockets available on the E1470A. You can also use individual single jacks from Johnson Components (P/N 131-4304-011/020) or standard SMB male connector jacks. The standard SMB male connector jacks do not allow for adjacent slots to be used due to their outside diameter size.

Jacks are for use with double-shielded cables RG316 and RG188. Cable hex crimp size is 0.151. Individual jacks for single-shielded cables are available from Johnson Components, P/N 131-4303-011 for use with single-shielded cables RG174, RG188, and RG316.

Johnson Components:

U.S.A.Tel.: 1-800-247-8256

Outside U.S.A. Tel.: (507) 835-6222

Fax.: (507) 835-8356

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis):	30 V
Maximum current (per channel or common):	
ac rms:	450 mA
Maximum power (per channel or common):	
ac:	10 VA

dc

Closed channel resistance (typical):	<1.5 Ω typ.
--------------------------------------	--------------------

ac

Note: For ac performance, $Z_L=Z_S=Z_0$, $\leq 40^\circ\text{C}$, RH $\leq 95\%$ for C-size, RH $\leq 65\%$ for B-size.

Characteristic impedance (Z_0):	50 Ω
Insertion loss:	
<10 MHz:	<0.25 typ.
<100 MHz:	<0.6 typ.
<500 MHz:	<3 dB (3:1)
Crosstalk (channel-to-channel):	
<10 MHz:	<-80 dB
<100 MHz:	<-60 dB
Crosstalk (channel-to-channel, one channel closed or channel-to-common) (terminated):	
<200 MHz:	<-50 dB
<500 MHz:	<-40 dB
VSWR:	
<100 MHz:	(3:1) <1.4
<200 MHz:	(3:1) <1.45
<500 MHz:	(3:1) <1.7

Additional Specifications

3 dB bandwidth:	
500 MHz:	3:1
200 MHz:	30:1
100 MHz:	60:1
Terminated isolation:	
10 MHz:	<-80 dB
100 MHz:	<-60 dB
200 MHz:	<-50 dB
(CH000-132 to COM 05 or CH200-322 to COM 25):	
500 MHz:	<-40 dB
3:1 VSWR (CH000-132 to COM 05 or CH200-322 to COM 25):	
100 MHz:	<1.4
200 MHz:	<1.45
500 MHz:	<1.7
30:1 VSWR (CH000-132 to COM 05 or CH200-322 to COM 25):	
200 MHz:	<1.5
60:1 VSWR (CH000-132 to COM 05 or CH200-322 to COM 25):	
100 MHz:	<1.5

(Agilent E1470A continued)

General Characteristics

Relays:	Non-latching armature
Power up/down state:	All open
Minimum relay life:	
No load:	5x10E6 operations
Rated load:	10E5 operations (10 W RF)

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website
(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	No
C-SCPI Series 700:	Yes
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Module Current

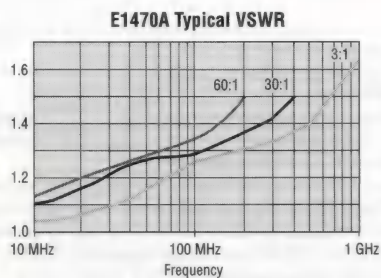
	I_{PM}	I_{DM}
+5 V:	3.5	0.01
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

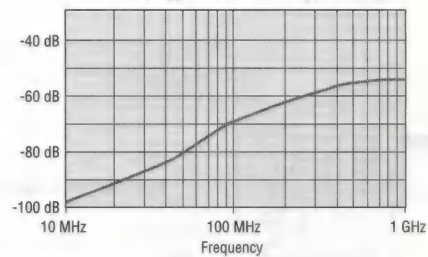
Watts/slot:	17.50
ΔP mm H ₂ O:	0.25
Air Flow liter/s:	1.30

Ordering Information

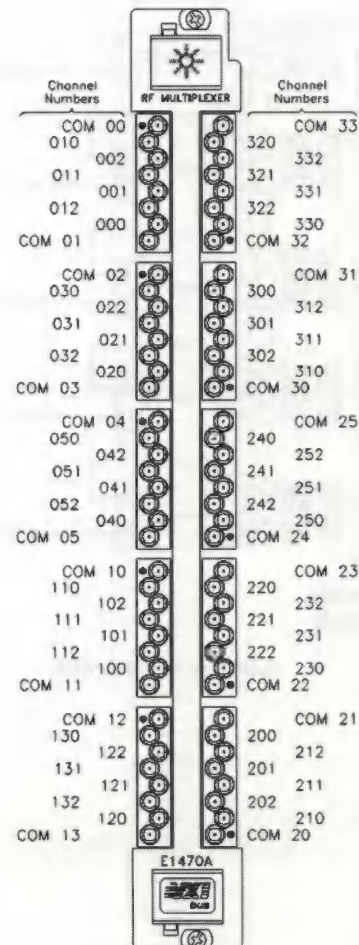
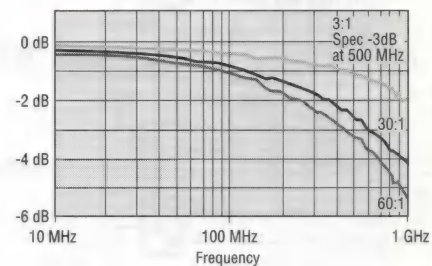
Description	Product No.
60-Channel RF Cascade Multiplexer	E1470A
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1470A W01



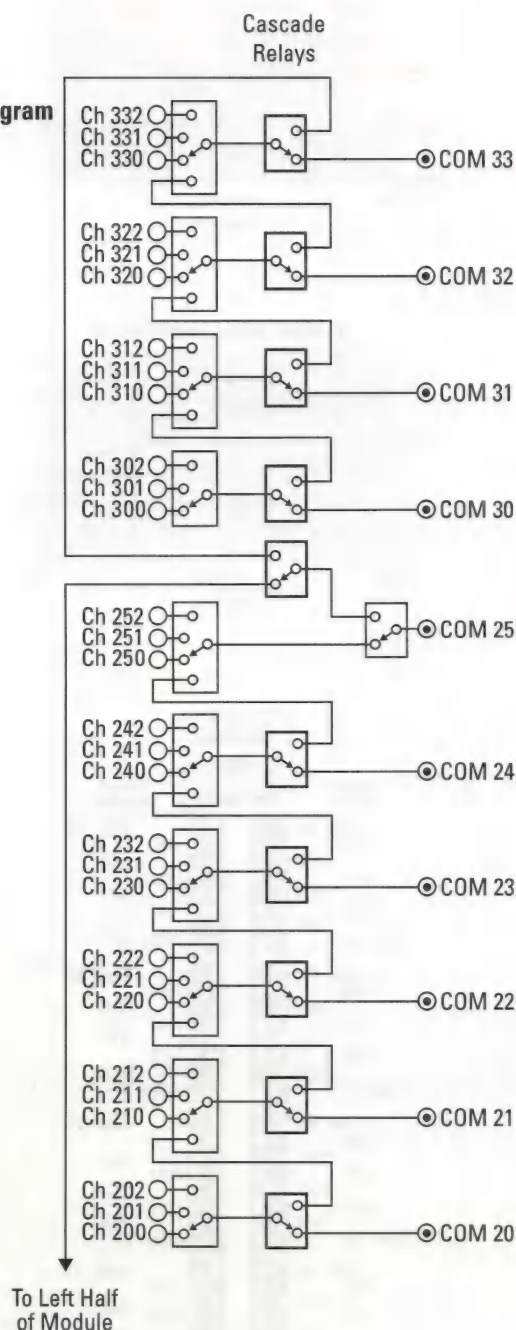
E1470A Typical Crosstalk (Ch-to-ch)



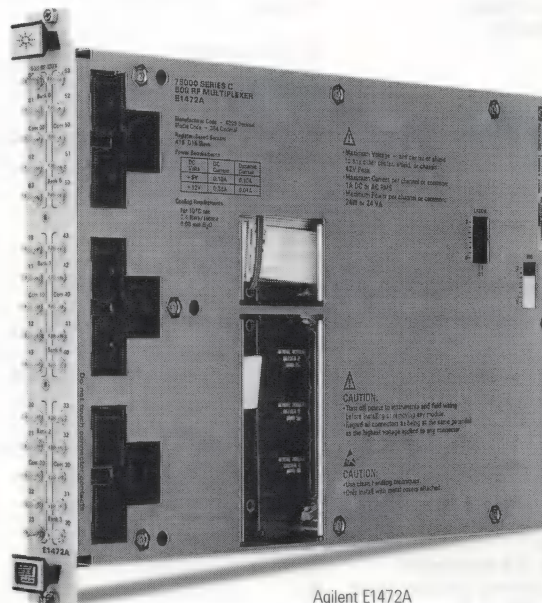
E1470A Typical Insertion Loss



(Agilent E1470A continued)

**E1470A
Circuit Diagram**

Publication No.: 5965-5610E

Six 1x4, 50 Ω RF Multiplexer**Agilent E1472A**

- 1-Slot, C-size, register based
- Six 1x4 multiplexers
- Switch signals up to 1.3 GHz
- SMB male connectors for high performance
- Controls E1473A/E1475A RF expanders
- Tree-switching for high isolation, low VSWR

Description

The Agilent Technologies E1472A 50 Ω RF Multiplexer is a C-size, 1-slot, register-based VXI module. It is the ideal choice to route test signals from your application to your test instruments (i.e., oscilloscope and spectrum, network, distortion analyzers, or other RF equipment). The E1472A is functionally identical to the E1474A except for output impedance.

The RF multiplexer can be used as six multiplexers or combined with others to form a larger tree-switched multiplexer or a limited stubless matrix. You can easily and inexpensively expand the E1472A via the E1473A 50 Ω RF multiplexer expander or via the E1475A 75 Ω RF multiplexer expander.

The E1472A can easily be programmed with SCPI commands to scan multiple channels, where each channel is switched to its common, one at a time. This module is arranged as six independent banks of channels (Bank 0 through Bank 5), each acting as a 1x4 one-wire multiplexer. Only one channel in each bank can be connected to its common at any time. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR. Each channel consists of a nonlatching armature relay.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Each channel consists of a non-latching armature relay. At power-on or reset, channels 00, 10, ... 50 are connected to COM 00, 10, ... 50, respectively, and all other channels are open (unterminated).

The RF multiplexer can be used as six multiplexers or combined with others to form a larger tree-switched multiplexer or a limited stubless matrix.

To expand the E1472A refer to the E1473A 50 Ω RF multiplexer expander or the E1475A 75 Ω RF multiplexer expander. The E1472A can control other external relays requiring 5 V, 12 V, or 24 V drive.

(Agilent E1472A continued)

Cables and Connectors

Various 50 Ω cables are available from Agilent for connecting to the SMB connectors on the front panel of the multiplexer. Adapters and other connectors are also available. Connectors are also available from Johnson Components.

Johnson Components:

U.S.A.Tel.: 1-800-247-8256

Outside U.S.A. Tel.: (507) 835-6222

Fax.: (507) 835-8356

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis):

42 V

Maximum current (per channel or common):

dc: 1 A

ac rms: 1 A

Maximum power (per channel or common):

dc: 24 W

ac: 24 VA

dc

Maximum thermal offset: 6 μ V

Closed channel resistance (typical): <1 Ω initial

Insulation resistance (between any two terminals): >10E8 Ω \leq 40° C, \leq 65% RH

ac

Note: For ac performance, ZL=ZS=Z0, \leq 40° C, RH \leq 95% for C-size, RH \leq 65% for B-size.

Characteristic impedance (Z0): 50 Ω

Insertion loss:

<10 MHz: <0.1 dB

<100 MHz: <0.4 dB

<500 MHz: <0.9 dB

<1.3 GHz: <1.5 dB

<3 GHz (typ): <8.0 dB

Crosstalk (channel-to-channel):

<10 MHz: <-90 dB

<100 MHz: <-80 dB

Crosstalk (channel-to-channel, one channel closed or channel-to-common) (terminated):

<200 MHz: n/a

<500 MHz: <-62 dB

<1.3 GHz: <-50 dB

<3 GHz (typ): n/a

VSWR:

<10 MHz: <1.05

<100 MHz: <1.15

<200 MHz: n/a

<500 MHz: <1.35

<1.3 GHz: <1.5

<3 GHz: n/a

Risetime: <300 ps

Signal delay: <3 ns

General Characteristics

Relays: Non-latching armature

Power up/down state: All open

Minimum relay life:

No load: 5x10E6 operations

Rated load: 10E5 operations

General Specifications

VXI Characteristics

VXI device type: Register based, A16, slave only

Size: C

Slots: 1

Connectors: P1/2

Shared memory: None

VXI buses: None

Instrument Drivers - See the Agilent Technologies Website

(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable

Command module firmware rev: A.02

I-SCPI Win 3.1: Yes

I-SCPI Series 700: Yes

C-SCPI LynxOS: Yes

C-SCPI Series 700: Yes

Panel Drivers: Yes

VXIplug&play Win Framework: Yes

VXIplug&play Win95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

Module Current

	I _{PM}	I _{DM}
+5 V:	0.1	0.1
+12 V:	0.36	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

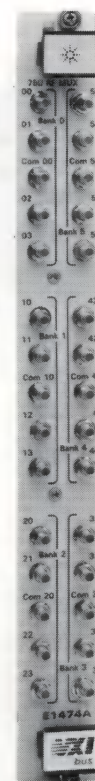
Watts/slot: 6.00

Δ P mm H₂O: 0.10

Air Flow liter/s: 0.50

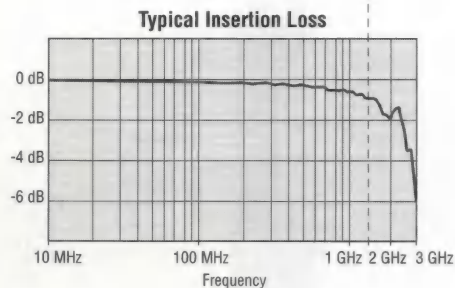
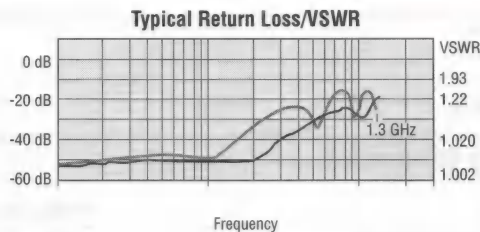
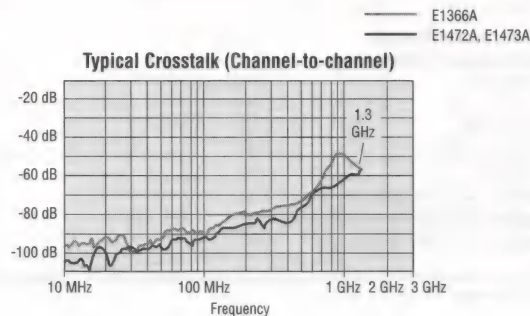
Ordering Information

Description	Product No.
Six 1x4, 50 Ω RF Multiplexer	E1472A
Service Manual	E1472A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1472A W01



Agilent E1472A front panel detail

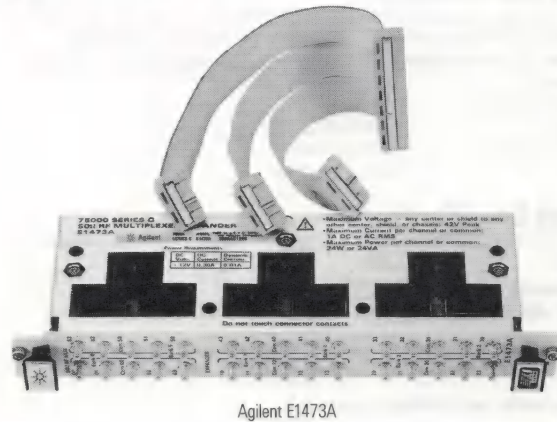
(Agilent E1472A continued)



Publication No.: 5965-5611E

Six 1x4, 50 Ω RF Multiplexer Expander

Agilent E1473A



- 1-Slot, C-size, register based
- Six 1x4 multiplexers
- Switch signals up to 1.3 GHz
- SMB male connectors for high performance
- Requires the E1472A/E1474A RF MUXes
- Can be externally mounted up to 8 meters away

Description

The Agilent Technologies E1473A 50 Ω RF Multiplexer Expander is a C-size, 1-slot, register-based VXI module. It is the ideal choice to inexpensively increase system switching capacity to switch test signals from your application to your test instruments such as oscilloscope and spectrum, network, distortion analyzers, or other RF equipment.

The E1473A expander is connected to, and requires, either an E1472A or E1474A RF multiplexer in the same system. Up to two E1473A multiplexer expanders can be connected to one multiplexer, providing a total of eighteen 1x4 multiplexer banks. You can mix and match the E1473A 50 Ω and E1475A 75 Ω expanders with the E1472A 50 Ω and E1474A 75 Ω multiplexers.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

The Agilent E1473A can be installed in a VXI C-size slot, adjacent to the E1472A (or E1474A), or rack mounted externally up to eight meters from the VXI mainframe using remote extender cables. The adjacent slot can be used by another module, making the multiplexer expander a slotless device. Remote installation of the E1473A expander close to the device under test allows the test cable length to be kept as short as possible, reducing signal delay and insertion loss.

If the expander is to be physically located away from the mainframe, order the Cable Extension Kit (P/N E1473-80002). Each kit includes two 0.8 meter cables, each controlling three of the six expander banks. Up to ten extender cables can be daisy-chained. Therefore, to remotely install one E1473A expander at a distance of eight meters, controlling all six multiplexer banks, requires ten E1473-80002 kits.

The switching sections of the E1473A 50 Ω RF multiplexer expander and the E1472A 50 Ω RF multiplexer are identical. Only one channel in each bank can be connected to its common at any time. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR. Each channel consists of a nonlatching armature relay. At power-on or reset, channels 00, 10, ... 50 are connected to COM 00, 10, ... 50, respectively, and all other channels are open (unterminated).

Cables and Connectors

Various 50 Ω cables are available from Agilent for connecting to the SNB connectors on the front panel of the multiplexer. Adapters and other connectors are also available. Connectors are also available from Johnson Components:

U.S.A.Tel.: 1-800-247-8256
Outside U.S.A. Tel.: (507) 835-6222
Fax.: (507) 835-8356

(Agilent E1473A continued)

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis):	42 V
Maximum current (per channel or common):	
dc:	1 A
ac rms:	1 A
Maximum power (per channel or common):	
dc:	24 W
ac rms:	24 VA

dc

Maximum thermal offset:	6 μ V
Closed channel resistance (typical):	<1 Ω initial
Insulation resistance (between any two terminals):	>10E8 Ω $\leq 40^\circ$ C, $\leq 65\%$ RH

ac

Note: For ac performance, $Z_L=Z_S=Z_0$, $\leq 40^\circ$ C, $\leq 95\%$ for C-size, RH $\leq 65\%$ for B-size.

Characteristic impedance (Z_0):	50 Ω
Insertion loss:	
<10 MHz:	<0.1 dB
<100 MHz:	<0.4 dB
<500 MHz:	<0.9 dB
<1.3 GHz:	<1.5 dB
<3 GHz (typ):	<8.0 dB
Crosstalk (channel-to-channel):	
<10 MHz:	<-90 dB
<100 MHz:	<-80 dB
Crosstalk (channel-to-channel, one channel closed or channel-to-common) (terminated):	
<200 MHz:	n/a
<500 MHz:	<-62 dB
<1.3 GHz:	<-50 dB
<3 GHz (typ):	n/a
VSWR:	
<10 MHz:	<1.05
<100 MHz:	<1.15
<200 MHz:	n/a
<500 MHz:	<1.35
<1.3 GHz:	<1.5
<3 GHz:	n/a
Risetime:	<300 ps
Signal delay:	<3 ns

General Characteristics

Relays:	Non-latching armature
Power up/down state:	All open
Minimum relay life:	
No load:	5x10E6 operations
Rated load:	10E5 operations

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.02
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes, with E1472A
VXIplug&play Win Framework:	Yes
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

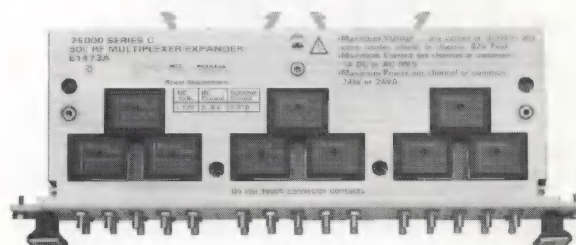
	I_{PM}	I_{DM}
+5 V:	0	0
+12 V:	0.36	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

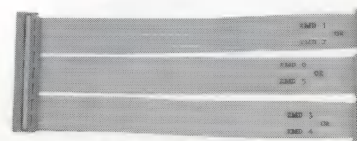
Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

Ordering Information

Description	Product No.
Six 1x4, 50 Ω RF Multiplexer Expander	E1473A
Service Manual	E1473A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1473A W01
RF MUX Cable Kit for E1473A RF Expander	E1473-80002

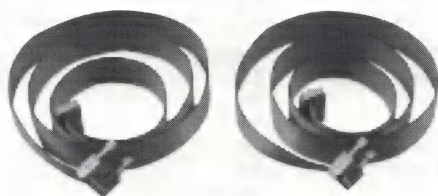


Agilent E1473A expander module top view

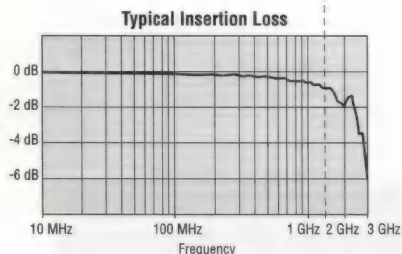
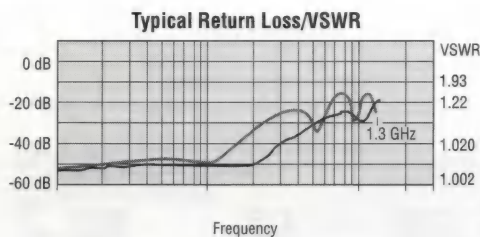
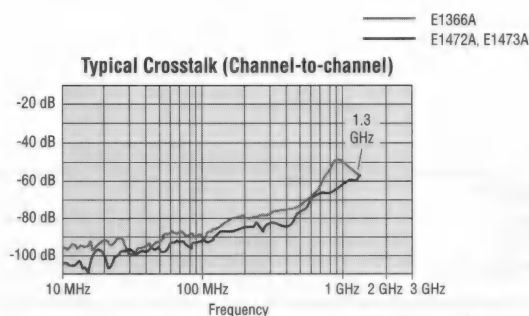


Module-to-backplane cables

(Agilent E1473A continued)



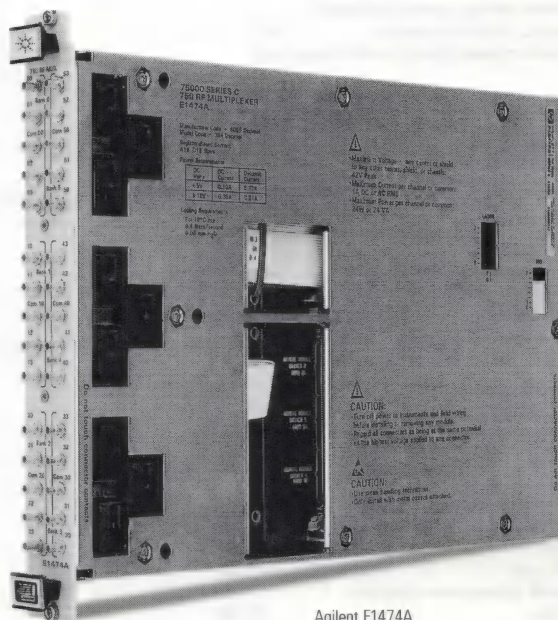
Remote expander cables



Publication No.: 5965-5615E

Six 1x4, 75 Ω RF Multiplexer

Agilent E1474A



Agilent E1474A

- 1-Slot, C-size, register based
- Six 1x4 multiplexers
- Switch signals up to 1.3 GHz
- SMB male connectors for high performance
- Controls the E1475A/E1473A RF expanders
- Tree switching for high isolation, low VSWR

Description

The Agilent Technologies E1474A 75 Ω RF Multiplexer is a C-size, 1-slot, register-based VXI module. It is the ideal choice for video and telecommunications applications. The E1474A is functionally identical to the E1472A except for output impedance.

The RF multiplexer can be used as six multiplexers or combined with others to form a larger tree-switched multiplexer or a limited stubless matrix. You can easily and inexpensively expand the E1474A via the E1475A 75 Ω RF multiplexer expander or via the E1473A 50 Ω RF multiplexer expander.

The E1474A can easily be programmed with SCPI commands to scan multiple channels, where each channel is switched to its common, one at a time. This module is arranged as six independent banks of channels (Bank 0 through Bank 5), each acting as a 1x4 one-wire multiplexer. Only one channel in each bank can be connected to its common at any time. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR. Each channel consists of a non-latching armature relay.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Each channel consists of a non-latching armature relay. At power-on or reset, channels 00, 10, ... 50 are connected to COM 00, 10, ... 50, respectively, and all other channels are open (unterminated).

The RF multiplexer can be used as six multiplexers or combined with others to form a larger tree-switched multiplexer or a limited stubless matrix.

To expand the E1474A refer to the E1475A 75 Ω RF multiplexer expander or the E1473A 50 Ω RF multiplexer expander. The E1474A can control other external relays requiring 5 V, 12 V, or 24 V drive.

(Agilent E1474A continued)

Cables and Connectors

Various 75 Ω cables are available from Agilent for connecting to the SNB connectors on the front panel of the multiplexer. Adapters and other connectors are also available. Connectors are also available from Johnson Components:

U.S.A. Tel.: 1-800-247-8256
Outside U.S.A. Tel.: (507) 835-6222
Fax.: (507) 835-8356

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis): 42 V

Maximum current (per channel or common):

dc: 1 A

ac rms: 1 A

Maximum power (per channel or common):

dc: 24 W

ac: 24 VA

dc

Maximum thermal offset: 6 μ V

Closed channel resistance (typical): <1 Ω initial

Insulation resistance (between any two terminals): >10E8 Ω \leq 40° C, \leq 65% RH

ac

Note: For ac performance, ZL=ZS=Z0, \leq 40° C, RH \leq 95% for C-size, RH \leq 65% for B-size.

Characteristic impedance (Z0): 75 Ω

Insertion loss:

<10 MHz: <0.3 dB

<100 MHz: <0.4 dB

<500 MHz: <0.8 dB

<1.3 GHz: <1.0 dB

<3 GHz (typ): n/a

Crosstalk (channel-to-channel):

<10 MHz: <-85 dB

<100 MHz: <-75 dB

Crosstalk (channel-to-channel, one channel closed or channel-to-common) (terminated):

<200 MHz: n/a

<500 MHz: <-60 dB

<1.3 GHz: <-42 dB

<3 GHz (typ): n/a

VSWR:

<10 MHz: <1.05

<100 MHz: <1.15

<200 MHz: n/a

<500 MHz: <1.35

<1.3 GHz: <1.5

<3 GHz: n/a

Risetime: <300 ps

Signal delay: <3 ns

General Characteristics

Relays: Non-latching armature

Power up/down state: All open

Minimum relay life:

No load: 5x10E6 operations

Rated load: 10E5 operations

General Specifications

VXI Characteristics

VXI device type: Register based, A16, slave only

Size: C

Slots: 1

Connectors: P1/2

Shared memory: None

VXI buses: None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable

Command module firmware rev: A.02

I-SCPI Win 3.1: Yes

I-SCPI Series 700: Yes

C-SCPI LynxOS: Yes

C-SCPI Series 700: Yes

Panel Drivers: Yes

VXIplug&play Win Framework: Yes

VXIplug&play Win95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

Module Current

	I _{PM}	I _{DM}
+5 V:	0.1	0.1
+12 V:	0.36	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

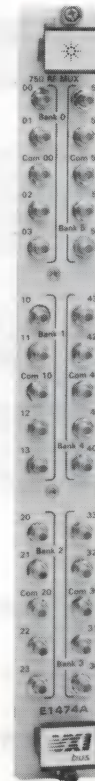
Watts/slot: 6.00

Δ P mm H₂O: 0.10

Air Flow liter/s: 0.50

Ordering Information

Description	Product No.
Six 1x4, 75 Ω RF Multiplexer	E1474A
Service Manual	E1474A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1474A W01
Component Lvl Info Pkt	E1472-90033

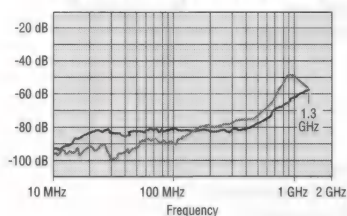


Agilent E1474A front panel detail

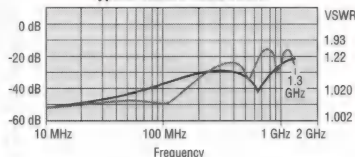
(Agilent E1474A continued)

— E1367A
— E1474A, E1475A

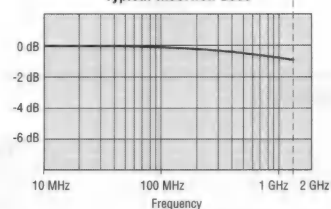
Typical Crosstalk (Channel-to-channel)



Typical Return Loss/VSWR



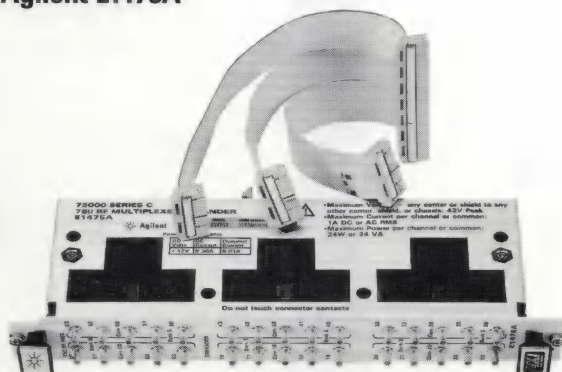
Typical Insertion Loss



Publication No.: 5965-9666E

Six 1x4, 75 Ω RF Multiplexer Expander

Agilent E1475A



Agilent E1475A

- 1-Slot, C-size, register based
- Six 1x4 multiplexers; switch signals up to 1.3 GHz
- SMB male connectors for high performance
- 75 Ω SMB male connectors (same size as 50 Ω)
- Used with the E1472A/E1474A
- Can be externally mounted up to 8 meters away

Description

The Agilent Technologies E1475A 75 Ω RF Multiplexer Expander is a C-size, 1-slot, register-based VXI module. It is the ideal choice to inexpensively increase system switching capacity for video and telecommunications applications.

The E1475A expander is connected to and requires either an E1472A or E1474A RF multiplexer in the same system. Up to two E1475A multiplexer expanders can be connected to one multiplexer, providing a total of eighteen 1x4 multiplexer banks. You can mix and match the E1475A 75 Ω and E1473A 50 Ω expanders with the E1474A 75 Ω and E1472A 50 Ω multiplexers.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

The Agilent E1475A can be installed in a VXI C-size slot, adjacent to the E1474A (or E1472A), or rack-mounted externally up to eight meters from the VXI mainframe using remote extender cables. The adjacent slot can be used by another module, making the multiplexer expander a slotless device. Remote installation of up to eight meters allows the E1475A expander to be located close to the device under test allowing the test cable length to be kept as short as possible, thus reducing signal delay and insertion loss.

If the expander is to be physically located away from the mainframe, order the Cable Extension Kit (P/N E1473-80002). Each kit includes two 0.8 meter cables, each cable controlling three of the six expander banks. Up to ten extender cables can be daisy-chained. Therefore, to remotely install one E1475A expander at a distance of eight meters, controlling all six multiplexer banks, requires ten E1473-80002 kits.

The switching sections of the E1475A 75 Ω RF multiplexer expander and the E1474A 75 Ω RF multiplexer are identical. Only one channel in each bank can be connected to its common at any time. The multiplexer relays are arranged in a tree-switched configuration, providing high isolation and low VSWR. Each channel consists of a nonlatching armature relay. At power-on or reset, channels 00, 10, . . . 50 are connected to COM 00, 10, . . . 50, respectively, and all other channels are open (unterminated).

Cables and Connectors

Various 75 Ω cables are available from Agilent for connecting to the SNB connectors on the front panel of the multiplexer. Adapters and other connectors are also available. Connectors are also available from Johnson Components:

U.S.A.Tel.: 1-800-247-8256
Outside U.S.A. Tel.: (507) 835-6222
Fax.: (507) 835-8356

Product Specifications

Input

Maximum voltage (center or shield-to-center, shield or chassis):	42 V
Maximum current (per channel or common):	
dc:	1 A
ac rms:	1 A
Maximum power (per channel or common):	
dc:	24 W
ac:	24 VA

dc

Maximum thermal offset:	6 μ V
Closed channel resistance (typical):	<1 Ω initial
Insulation resistance (between any two terminals):	>10E8 Ω \leq 40° C, \leq 65% RH

(Agilent E1475A continued)

ac**Note:** For ac performance, $Z_L=Z_S=Z_0$, $\leq 40^\circ\text{C}$, RH $\leq 95\%$.

Characteristic impedance (Z_0):	75 Ω
Insertion loss:	
<10 MHz:	<0.3 dB
<100 MHz:	<0.4 dB
<500 MHz:	<0.8 dB
<1.3 GHz:	<1.0 dB
<3 GHz (typ):	n/a
Crosstalk (channel-to-channel):	
<10 MHz:	<-85 dB
<100 MHz:	<-75 dB
Crosstalk (channel-to-channel, one channel closed or channel-to-common) (terminated):	
<200 MHz:	n/a
<500 MHz:	<-60 dB
<1.3 GHz:	<-42 dB
<3 GHz (typ):	n/a
VSWR:	
<10 MHz:	<1.05
<100 MHz:	<1.15
<200 MHz:	n/a
<500 MHz:	<1.35
<1.3 GHz:	<1.5
<3 GHz:	n/a
Risetime:	<300 ps
Signal delay:	<3 ns

General Characteristics

Relays:	Non-latching armature
Power up/down state:	All open
Minimum relay life:	
No load:	5x10E6 operations
Rated load:	10E5 operations

General Specifications**VXI Characteristics**

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.02
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes, with E1474A
VXIplug&play Win Framework:	Yes
VXIplug&play Win95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

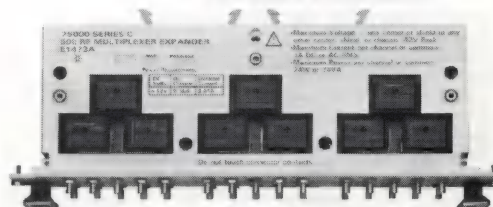
	I_{PM}	I_{DM}
+5 V:	0	0
+12 V:	0.36	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

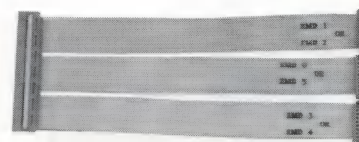
Watts/slot:	1.00
ΔP mm H₂O:	0.02
Air Flow liter/s:	0.10

Ordering Information

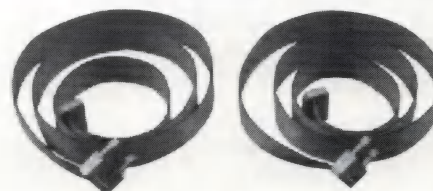
Description	Product No.
Six 1x4, 75 Ω RF Multiplexer Expander	E1475A
Service Manual	E1475A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E1475A W01
RF MUX Cable Kit for E1473A RF Expander	E1473-80002



Agilent E1475A expander module top view

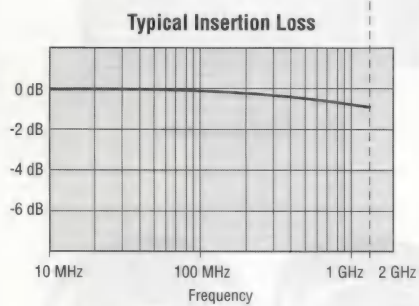
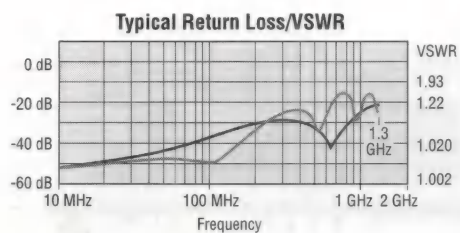
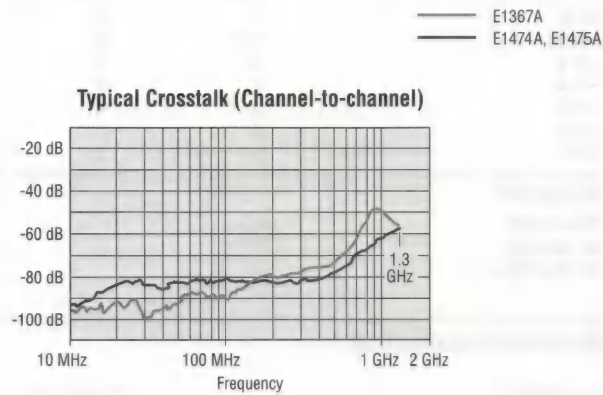


Module-to-backplane cables



Remote expander cables

(Agilent E1475A continued)



Publication No.: 5965-5617E

[illegible]

The diagram illustrates the internal architecture of the E1411B Multimeter. It shows a front panel with a circular display and a small indicator light. Below these are three vertical slots, each containing a multiplexer. These multiplexers are connected to a Command Module or VXI Controller via a series of daisy-chain cables. The diagram also shows a separate view of the Command Module or VXI Controller, which contains a multimeter and multiple multiplexers. The daisy-chain cables connect the multiplexers in the Command Module to the multiplexers in the Multimeter.

Product No.	Description
E1343A	16-Channel High-Voltage Relay MUX
E1344A	16-Channel High-Voltage Relay MUX
E1345A	16-Channel Relay Multiplexer
E1346A	48-Channel Single-Ended Relay MUX
E1347A	16-Channel Thermocouple Relay MUX

Product No.	Description
E1460A	64-Channel Relay Multiplexer
E1476A	64-Channel 3-Wire Relay MUX w/ Thermocouple
E460A	256-Channel Reed Relay Multiplexer
E8462A	256-Channel Armature Relay Multiplexer

Also, by using Agilent's analog bus cables to connect an Agilent DMM module to one or more multiplexers (available on B-size and C-size multiplexers only), a scanning multimeter function is possible. This configuration may be programmed as a "single" instrument.

Agilent Technologies offers multiplexers with a wide variety of functionality to meet your test system needs. The E1460A multiplexer with high-density latching armature switches, and the E8462A with high-density non-latching armature switches both feature highly configurable, high point-count switching topology.

Agilent E8460A, E1476A, E1343A/E1345A, or E1344/E1347A. These relays provide high-integrity voltage measurements with low thermal offset (E1476A) to high-voltage capability or low thermal offset performance general-purpose reed relay multiplexers (E1343A/E1345A).

The Agilent E1344A/E1347A module offers thermocouple compensation in addition to functionality as a general-purpose reed relay multiplexer.

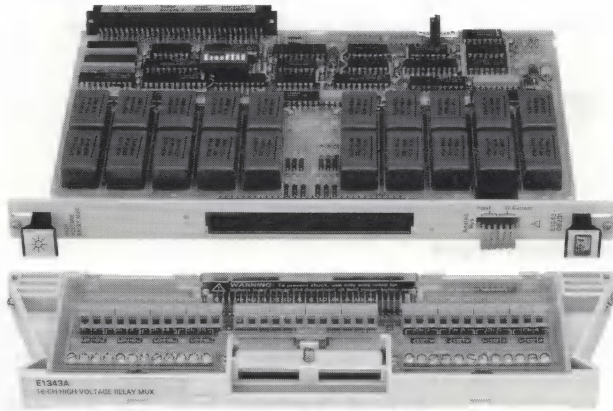
Family Specifications

Model	E1343A E1344A	E1345A E1347A	E1346A	E1460A	E1476A	E8460A	E8462A
	High-Voltage Relay MUX	Low-Offset Relay MUX	Single-Ended Relay MUX	High-Density Relay MUX	High-Density T/C Relay MUX	High-Density Relay MUX	High-Density Relay MUX
Channels:	16 3-wire	16 3-wire	48 1-wire	64 2-wire	64 3-wire	256 1-wire 128 2-wire 64 4-wire	256 1-wire 128 2-wire 64 4-wire
Relay type:	Reed	Reed	Reed	Armature	Reed	Reed	Armature
Input							
Maximum V (any term. to any other term. or chassis):							
dc:	250 Vdc	120 Vdc	120 Vdc	220 Vdc	120 Vdc	200 V	250 V
ac rms:	354 V rms	170 V rms	170 V rms	250 V rms	120 Vac	140 V	250 V
ac peak:	—	—	—	—	—	200 V	350 V
Max. current (per channel common, non-inductive):	50 mA	50 mA	50 mA	1 Adc/ac rms (<30 Vdc), 0.3 Adc/ac rms (<133 Vdc) ⁽¹⁾	35 mA	300 mA	2 A at 30 Vdc
Max. power per channel:	1 VA	1 VA	1 VA	40 VA ⁽²⁾	4 VA	5 VA	60 VA
dc							
Max. thermal offset per channel, differential Hi-Lo:	10 μ V	4 μ V	50 μ V	7 μ V	<4 μ V, <2 μ V (10 samples averaged)	n/a	\pm 3 μ V (1-wire), \pm 1.5 μ V (2-wire)
Closed channel resistance:	100 Ω \pm 10%	100 Ω \pm 10%	100 Ω \pm 10%	<1.5 Ω	100 Ω \pm 5 Ω	<3 Ω	<0.5 Ω
ac							
Minimum bw (-3 dB, 50 Ω source/load):	10 MHz (protection resistors shorted)	10 MHz (protection resistors shorted)	10 MHz (protection resistors shorted)	10 MHz 2-wire, 3 MHz 1-wire	100 kHz	256 x 1: 4.5 MHz, 16 x 1: 30.0 MHz	256 x 1: 6 MHz 32 x 1: 30 MHz
General							
Minimum relay life:							
No load:	10E8 Operations	10E8 Operations	10E8 Operations	5x10E6 Operations	5x10E9 Operations	500 M Operations	1 M Operations
Rated load:	10E7 Operations	10E7 Operations	10E7 Operations	10E5 Operations	10E7 Operations	10 M Operations (Max. rated resistive load)	100 K Operations
VXI Characteristics							
Size:	B	B	B	C	C	C	C
Slots:	1	1	1	1	1	1	1
VXI device type:	Register based	Register based	Register based	Register based	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.							
VXIplug&play Win Framework:	Yes	Yes	No	Yes	Yes	No	No
VXIplug&play Win 95/NT Framework:	Yes	Yes	No	Yes	Yes	Yes	Yes
VXIplug&play HP-UX Framework:	No	No	No	No	No	No	No

⁽¹⁾ 0.18 Adc/Adc rms (<220 Vdc)⁽²⁾ FET lifetime is independent of number of switching operations.

16-Channel High-Voltage Relay Multiplexer

Agilent E1343A



Agilent E1343A

- 1-Slot, B-size, register based
- General purpose, high-voltage relay multiplexer
- High-voltage measurements up to 250 V
- 16-channel 3-wire or 8-channel 4-wire multiplexer
- Shunt/series signal conditioning elements
- Channel scanning with Agilent DMMs

Description

The Agilent Technologies E1343A General-Purpose Reed Relay Multiplexer is a B-size, 1-slot, register-based Agilent VXI module with high-voltage capability. It switches 16 channels of high, low, and guard each. This multiplexer consists of a B-size component card (labeled E1343-66201) and a screw terminal block that plugs into the component card. The E1343A is functionally similar to the E1344A.

Tree-switched common high, low, and guard screw terminals and analog bus connections provide access to all 16 channels. This module can operate as either a single 1x16 three-wire multiplexer, two independent 1x8 three-wire multiplexers (for four-wire Ω), or a 1x8 six-wire multiplexer.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

The multiplexer is arranged into two banks of eight switches, each having its own common high, low, and guard screw terminals accessible on the terminal block. Tree-switched common high, low, and guard screw terminals and analog bus connections provide access to all 16 channels. Closing the channel switches and tree switches using the SCPI command [ROUTE:]CLOSe operates the module as either a single 1x16 three-wire multiplexer, two independent 1x8 three-wire multiplexers (for four-wire Ω), or a 1x8 six-wire multiplexer. The E1343A component card is also used in the E1344A.

One analog bus cable is shipped with each module, making it easy to connect common outputs together for slot-adjacent modules. If you are using a B-size mainframe, Agilent E1300B or E1301B, use the analog bus cable shipped with the E1326B DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1343A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:	
Maximum voltage (any terminal to any other terminal or chassis):	250 Vdc
ac rms:	
Maximum voltage (any terminal to any other terminal or chassis):	250 V rms
Maximum current (per channel common, non-inductive):	50 mA
Maximum power per channel:	1 VA

dc

Maximum thermal offset per channel, differential Hi-Lo:	10 μ V
Closed channel resistance:	100 $\Omega \pm 10\%$
Insulation resistance (between any two points):	10E9 Ω
Insulation resistance (Hi to Lo, power off):	n/a

ac

Minimum bandwidth (–3 dB, 50 Ω source/load):	10 MHz (protection resistors shorted)
Crosstalk (channel-to-channel):	
100 kHz:	–80 dB
10 MHz:	–40 dB
Both:	n/a
Closed channel capacitance:	<150 pF Hi-Lo, <150 pF Lo-Guard, <2000 pF Guard-Chassis

General Characteristics

Relays:	Reed relays Break-before-make
Power down state:	Relays open on power down
Power up state:	Relays open on power up
Minimum relay life:	
No load:	10E8 operations
Rated load:	10E7 operations
Screw terminal wire size:	16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)
Scanning rate:	350 channels/s typ.

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

(Agilent E1343A continued)

Module Current

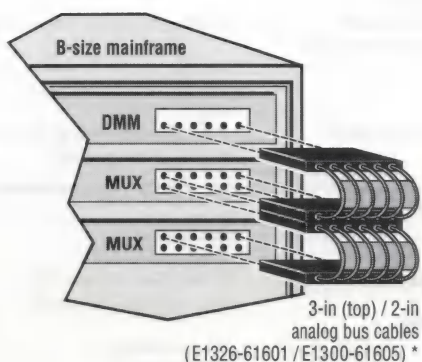
	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

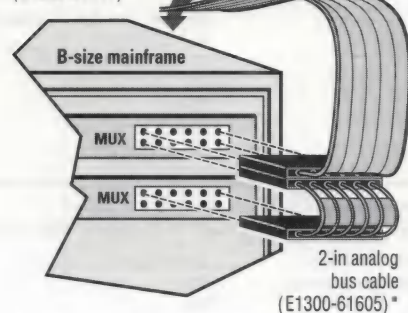
Ordering Information

Description	Product No.
16-Channel High Voltage Relay Multiplexer	E1343A
Service Manual	E1343A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1343A W01
E1343A Screw Terminal Module	E1343-80001



Analog bus cables for MUX-to-MUX and MUX-to-multimeter connections

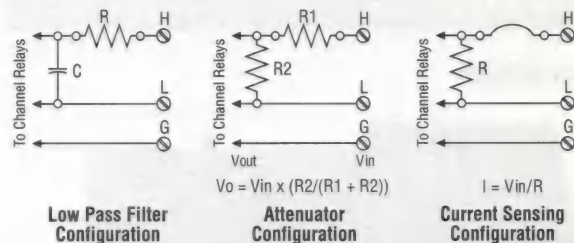
19.5-in analog bus cable to internal DMM (E1326-61611) **



* DMM-to-MUX and MUX-to-MUX analog bus cables are provided with the purchase of the DMM and MUX modules respectively.

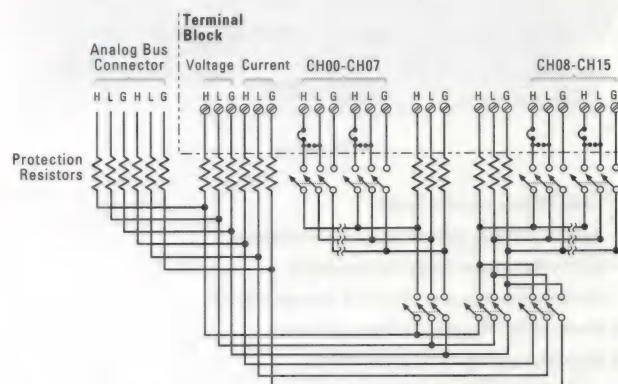
** 19.5-in analog bus cable is provided with purchase of E1300/01B Series B mainframe with internal DMM option.

Analog bus cables for MUX-to-MUX and MUX-to-multimeter connections



Signal Conditioning Components/Current Shunt

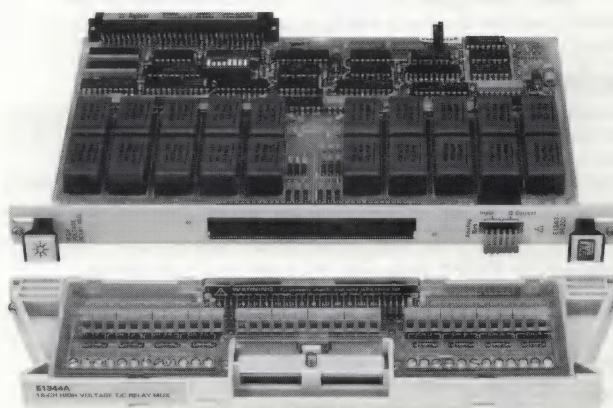
E1343A Circuit Diagram



Publication No.: 5965-5599E

16-Channel T/C High-Voltage Relay Multiplexer

Agilent E1344A



Agilent E1344A

- 1-Slot, B-size, register based
- High-voltage measurements up to 250 V
- Built-in thermistor reference junction
- Channel scanning with Agilent DMMs
- 16-channel 3-wire or 8-channel 4-wire multiplexer
- Thermocouple compensated reed relay multiplexer

(Agilent E1344A continued)

Description

The Agilent Technologies E1344A Thermocouple Compensated High-Voltage Reed Relay Multiplexer is a **B-size, 1-slot, register-based VXI module** that switches 16 channels of high, low, and guard each. The multiplexer module consists of a B-size component card (labeled E1343-66201) and a screw terminal block that plugs onto the component card. The E1344A is functionally similar to the E1343A.

Using the Agilent E1326B or E1411B DMMs, the E1344A performs channel scanning with automatic conversions for many thermocouple types. Temperature measurements are made with automatic cold junction compensation. SCPI commands are also used to set up measurements. The card, in conjunction with Agilent VXI DMMs, also measures voltage, current, and two- and four-wire resistance.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

One analog bus cable is shipped with each module, making it easy to connect multiplexer common outputs together for slot-adjacent modules. If you are using a B-size mainframe, Agilent E1300B or E1301B, use the analog bus cable shipped with the E1326B DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1344A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:
Maximum voltage (any terminal to any other terminal or chassis): 250 Vdc

ac rms:
Maximum voltage (any terminal to any other terminal or chassis): 250 V rms
Maximum current (per channel common, non-inductive): 50 mA
Maximum power per channel: 1 VA

dc

Maximum thermal offset per channel, differential Hi-Lo: 10 μ V
Closed channel resistance: 100 $\Omega \pm 10\%$
Insulation resistance (between any two points): 10E9 Ω
Insulation resistance (Hi to Lo, power off): n/a

ac

Minimum bandwidth (-3 dB, 50 Ω source/load): 10 MHz (protection resistors shorted)
Crosstalk (channel-to-channel):
100 kHz: -80 dB
10 MHz: -40 dB
Both: n/a
Closed channel capacitance: <150 pF Hi-Lo, <150 pF Lo-Guard, <2000 pF Guard-Chassis

General Characteristics

Relays: Reed relays
Break-before-make
Relays open on power down
Relays open on power up

Power down state:
Power up state:
Minimum relay life:
No load: 10E8 operations
Rated load: 10E7 operations
Screw terminal wire size: 16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)
Scanning rate: 350 channels/s typ.

General Specifications

VXI Characteristics

VXI device type: Register based, A16, slave only
Size: B
Slots: 1
Connectors: P1
Shared memory: None
C-size compatibility: Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable
Command module firmware rev: A.06
I-SCPI Win 3.1: Yes
I-SCPI Series 700: Yes
C-SCPI LynxOS: Yes
C-SCPI Series 700: Yes
Panel Drivers: Yes
VXIplug&play Win Framework: Yes
VXIplug&play Win 95/NT Framework: Yes
VXIplug&play HP-UX Framework: No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

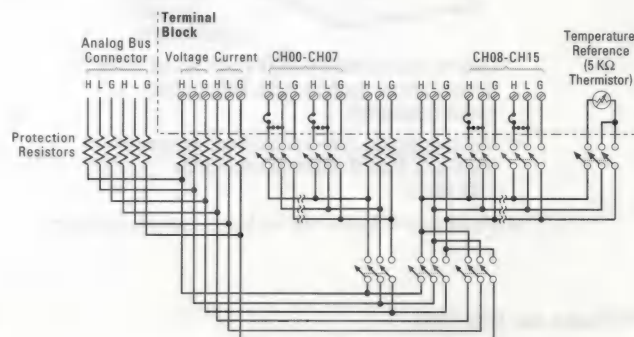
Cooling/Slot

Watts/slot: 1.00
 ΔP mm H₂O: 0.02
Air Flow liter/s: 0.10

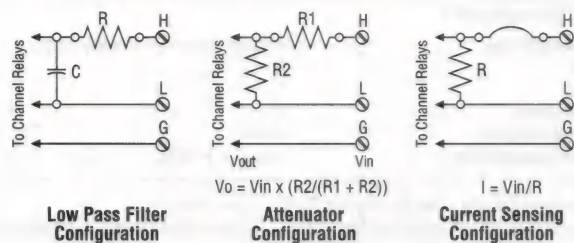
Ordering Information

Description	Product No.
16-Ch. T/C High-Voltage Relay Multiplexer	E1344A
Service Manual	E1344A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1344A W01
E1344A Screw Terminal Module	E1344-80001

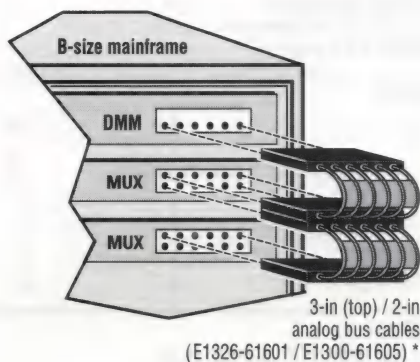
E1344A Circuit Diagram



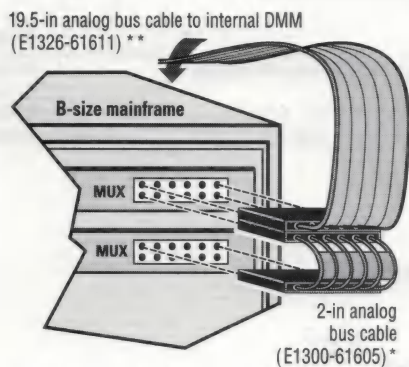
(Agilent E1344A continued)



Signal Conditioning Components/Current Shunt



Analog bus cables for MUX-to-MUX and MUX-to-multimeter connections



* DMM-to-MUX and MUX-to-MUX analog bus cables are provided with the purchase of the DMM and MUX modules respectively.

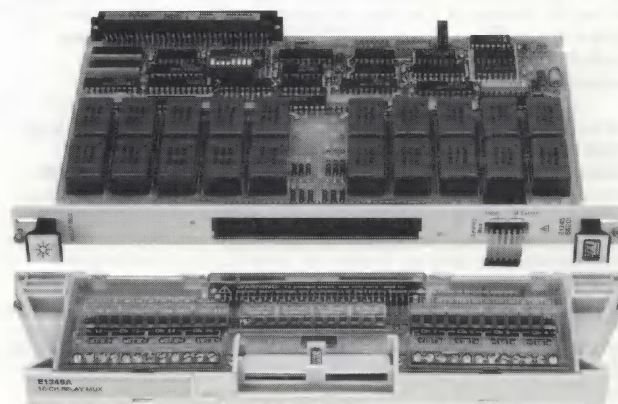
** 19.5-in analog bus cable is provided with purchase of E1300/01B Series B mainframe with internal DMM option.

Analog bus cables for MUX-to-MUX and MUX-to-multimeter connections

Publication No.: 5965-5600E

16-Channel Low-Offset Relay Multiplexer

Agilent E1345A



Agilent E1345A

- 1-Slot, B-size, register based
- General purpose, low-offset relay multiplexer
- Low thermal offset reed relays, <4 μ V
- 16-channel 3-wire or 8-channel 4-wire multiplexer
- Shunt/series signal conditioning elements
- Channel scanning with Agilent DMMs

Description

The Agilent Technologies E1345A General-Purpose Reed Relay Multiplexer is a B-size, 1-slot, register-based VXI module that switches 16 channels of high, low, and guard each. The multiplexer has low thermal offset performance. This module consists of a B-size component card (labeled E1345-66201) and a screw terminal block that plugs onto the component card. The E1345A is functionally similar to the E1347A.

The E1345A multiplexer is arranged into two banks of eight switches, each having its own common high, low, and guard screw terminals accessible on the terminal block. Tree-switched common high, low, and guard screw terminals and analog bus connections provide access to all 16 channels. The module may be programmed as either a single 1x16 three-wire multiplexer, two independent 1x8 three-wire multiplexers (for four-wire Ω), or a 1x8 six-wire multiplexer.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

One analog bus cable is shipped with each module, making it easy to connect common outputs together for slot-adjacent modules. If you are using a B-size mainframe, Agilent E1300B or E1301B, use the analog bus cable shipped with the E1326B DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1345A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis):

120 Vdc

ac rms:

Maximum voltage (any terminal to any other terminal or chassis):

120 V rms

Maximum current (per channel common, non-inductive):

50 mA

Maximum power per channel:

1 VA

(Agilent E1345A continued)

dc

Maximum thermal offset per channel, differential Hi-Lo:	4 μ V
Closed channel resistance:	100 $\Omega \pm 10\%$
Insulation resistance (between any two points):	10E9 Ω
Insulation resistance (Hi to Lo, power off):	n/a

ac

Minimum bandwidth (-3 dB, 50 Ω source/load):	10 MHz (protection resistors shorted)
Crosstalk (channel-to-channel):	
100 kHz:	-70 dB
10 MHz:	-20 dB
Both:	n/a
Closed channel capacitance:	<150 pF Hi-Lo, <150 pF Lo-Guard, <2000 pF Guard-Chassis

General Characteristics

Relays:	Reed relays Break-before-make Relays open on power down Relays open on power up
Minimum relay life:	
No load:	10E8 operations
Rated load:	10E7 operations
Screw terminal wire size:	16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)
Scanning rate:	600 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

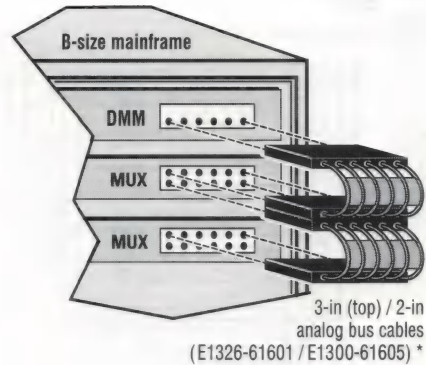
	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

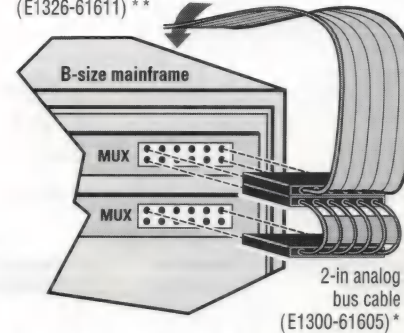
Ordering Information

Description	Product No.
16-Channel Low-Offset Relay Multiplexer	E1345A
Service Manual	E1345A 0B3
Japan - Japanese Localization	E1345A ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1345A W01
Extra terminal block for the E1345A	E1345-80001



Analog bus cables for MUX-to-MUX and MUX-to-multimeter connections

19.5-in analog bus cable to internal DMM (E1326-61611) **



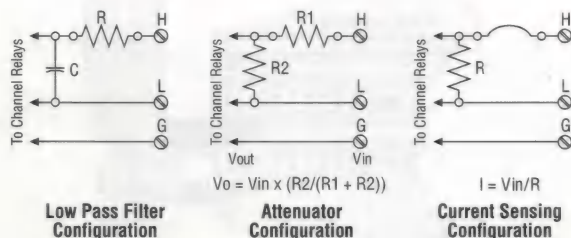
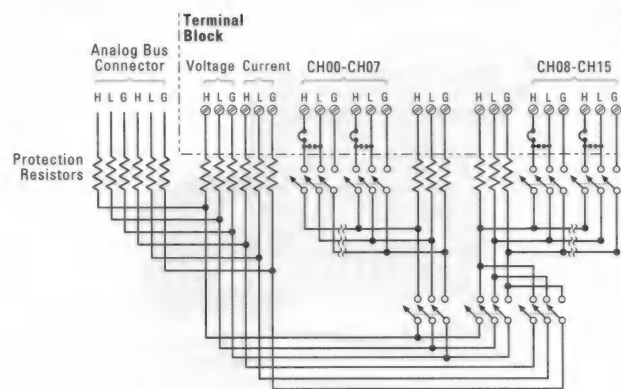
* DMM-to-MUX and MUX-to-MUX analog bus cables are provided with the purchase of the DMM and MUX modules respectively.

** 19.5-in analog bus cable is provided with purchase of E1300/01B Series B mainframe with internal DMM option.

Analog bus cables for MUX-to-MUX and MUX-to-multimeter connections

(Agilent E1345A continued)

E1345A Circuit Diagram

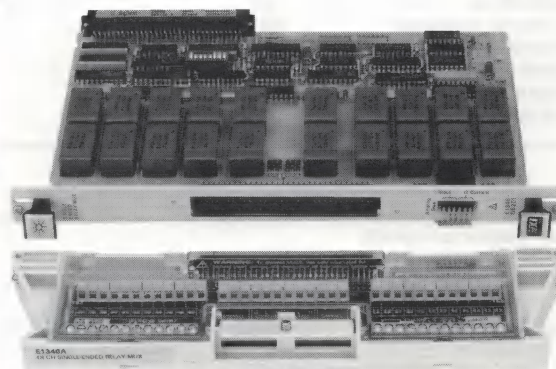


Signal Conditioning Components/Current Shunt

Publication No.: 5965-5601E

48-Channel Single-Ended Relay Multiplexer

Agilent E1346A



Agilent E1346A

- 1-Slot, B-size, register based
- 48 single-ended channels
- Common low and guard terminals
- Channel scanning with Agilent DMMs
- Analog bus connector on the faceplate

Description

The Agilent Technologies E1346A Single-Ended Relay Multiplexer is a **B-size, 1-slot, register-based VXI module** that switches 48 channels of high connections and one channel each of low and guard. This module consists of a component and a terminal block that plugs onto the component card. An analog bus connector on the faceplate provides easy connection to an E1326B DMM, E1411B DMM, and/or other slot-adjacent multiplexers.

Common high, low, and guard signals are connected by tree switch to both the tree-switch terminals on the terminal card and the analog bus connector. Removal of a factory-installed jumper on the component card isolates the low from the guard input. One analog bus cable is shipped with each module, making it easy to connect multiplexer common outputs together for slot-adjacent modules.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Common high, low, and guard signals are connected by tree switch to both the tree-switch terminals on the terminal card and the analog bus connector. Removal of a factory-installed jumper on the component card isolates the low from the guard input. One analog bus cable is shipped with each module, making it easy to connect multiplexer common outputs together for slot-adjacent modules. If you are using a B-size mainframe, Agilent E1300B or E1301B, use the analog bus cable shipped with the E1326A DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1346A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis): 120 Vdc

ac rms:

Maximum voltage (any terminal to any other terminal or chassis): 120 V rms

Maximum current

(per channel common,

non-inductive): 50 mA

Maximum power per channel: 1 VA

(Agilent E1346A continued)

dc

Maximum thermal offset per channel, differential Hi-Lo:	50 μ V
Closed channel resistance:	100 $\Omega \pm 10\%$
Insulation resistance (between any two points):	10E9 Ω
Insulation resistance (Hi to Lo, power off):	n/a

ac

Minimum bandwidth (-3 dB, 50 Ω source/load):	10 MHz (protection resistors shorted)
Crosstalk (channel-to-channel):	
100 kHz:	-70 dB
10 MHz:	-20 dB
Both:	n/a
Closed channel capacitance:	<150 pF Hi-Lo, <150 pF Lo-Guard, <2000 pF Guard-Chassis

General Characteristics

Relays:	Reed relays Break-before-make Relays open on power down Relays open on power up
Power down state:	
Power up state:	
Minimum relay life:	
No load:	10E8 operations
Rated load:	10E7 operations
Screw terminal wire size:	16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)
Scanning rate:	600 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.01
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	No
VXIplug&play HP-UX Framework:	No

Module Current

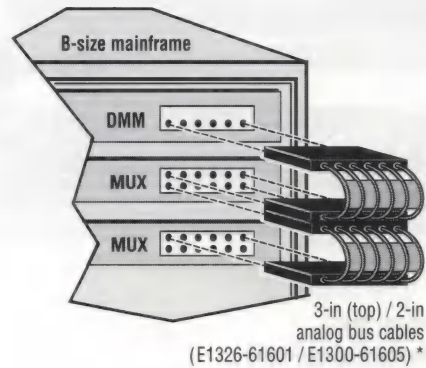
	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

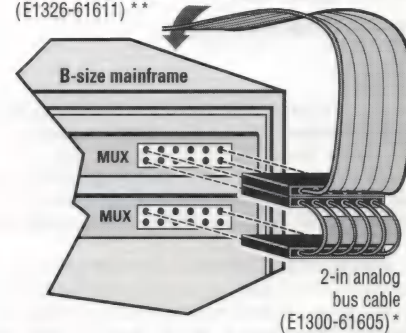
Ordering Information

Description	Product No.
48-Channel Single-Ended Relay Multiplexer	E1346A
Service Manual	E1346A 0B3
Japan - Japanese Localization	E1346A ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1346A W01
Extra terminal block for the E1346A	E1346-80001



Analog bus cabling for MUX-to-MUX and MUX-to-multimeter

19.5-in analog bus cable to internal DMM (E1326-61611) **

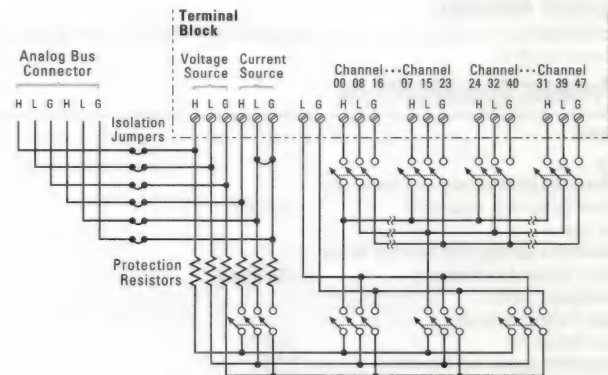


* DMM-to-MUX and MUX-to-MUX analog bus cables are provided with the purchase of the DMM and MUX modules respectively.

** 19.5-in analog bus cable is provided with purchase of E1300/01B Series B mainframe with internal DMM option.

Analog bus cabling for MUX-to-MUX and MUX-to-multimeter

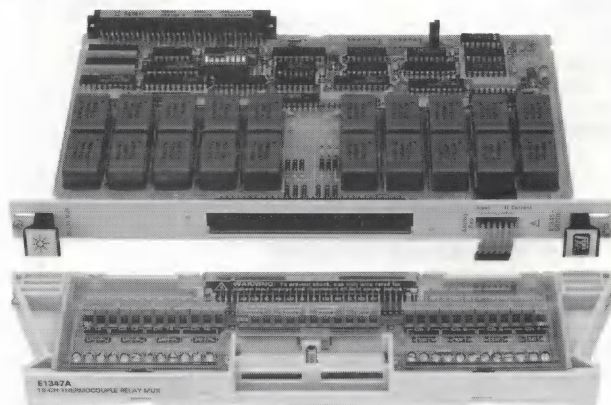
E1346A Circuit Diagram



Publication No.: 5965-5602E

16-Channel T/C Low-Offset Relay Multiplexer

Agilent E1347A



Agilent E1347A

- 1-Slot, B-size, register based
- Low-thermal offset reed relays, $<4 \mu\text{V}$
- Built-in thermistor reference junction
- 16-channel 3-wire or 8-channel 4-wire multiplexer
- Channel scanning with Agilent DMMs
- Measures temperature, voltage, and current

Description

The Agilent Technologies E1347A General-Purpose Reed Relay Multiplexer is a B-size, 1-slot, register-based VXI module with thermocouple compensation. It switches 16 channels of high, low, and guard each. The module has low-thermal offset performance. The multiplexer module consists of a B-size component card (labeled E1345-66201) and a screw terminal block that plugs onto the component card. The E1347A is functionally similar to the E1345A.

Using the E1326B or E1411B DMMs, the E1347A performs channel scanning with automatic conversions for many thermocouple types. Temperature measurements are made with automatic cold junction compensation. The card, in conjunction with Agilent VXI DMMs, also measure voltage, current, and two- and four-wire Ω .

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

One analog bus cable is shipped with the module, making it easy to connect multiplexer common outputs together for slot-adjacent modules. If you are using a B-size mainframe, Agilent E1300B or E1301B, use the analog bus cable shipped with the E1326B DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1347A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis): 120 Vdc

ac rms:

Maximum voltage (any terminal to any other terminal or chassis): 120 V rms

Maximum current (per channel common, non-inductive): 50 mA
Maximum power per channel: 1 VA

dc

Maximum thermal offset per channel,

differential Hi-Lo:	4 μV
Closed channel resistance:	100 $\Omega \pm 10\%$
Insulation resistance (between any two points):	10E9 Ω
Insulation resistance (Hi to Lo, power off):	n/a

ac

Minimum bandwidth (–3 dB, 50 Ω source/load):	10 MHz (protection resistors shorted)
Crosstalk (channel-to-channel):	
100 kHz:	–80 dB
10 MHz:	–40 dB
Both:	n/a
Closed channel capacitance:	<150 pF Hi-Lo, <150 pF Lo-Guard, <2000 pF Guard-Chassis

General Characteristics

Relays:

Reed relays
Break-before-make
Relays open on power down
Relays open on power up
Relays open on power down
Relays open on power up

Power down state:

Power up state:

Minimum relay life:

No load: 10E8 operations
Rated load: 10E7 operations

Reference junction measurement accuracy (18 to 28° C operating):

0.3° C

Strain gage excitation:

n/a

Screw terminal wire size:

16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)

Scanning rate:

600 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
–12 V:	0	0
+24 V:	0	0
–24 V:	0	0
–5.2 V:	0	0
–2 V:	0	0

(Agilent E1347A continued)

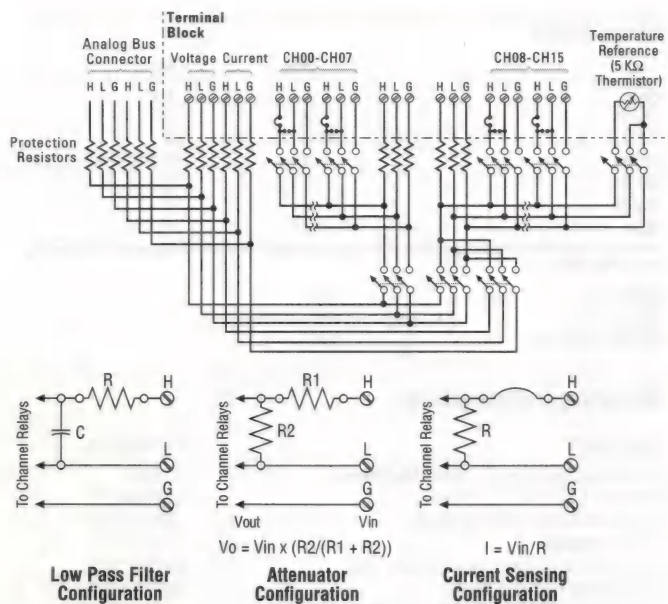
Cooling/Slot

Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

Ordering Information

Description	Product No.
16-Ch. T/C Low-Offset Relay Multiplexer	E1347A
Service Manual	E1347A 0B3
Japan - Japanese Localization	E1347A ABJ
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1347A W01
Extra terminal block for the E1347A	E1347-80001

E1347A Circuit Diagram

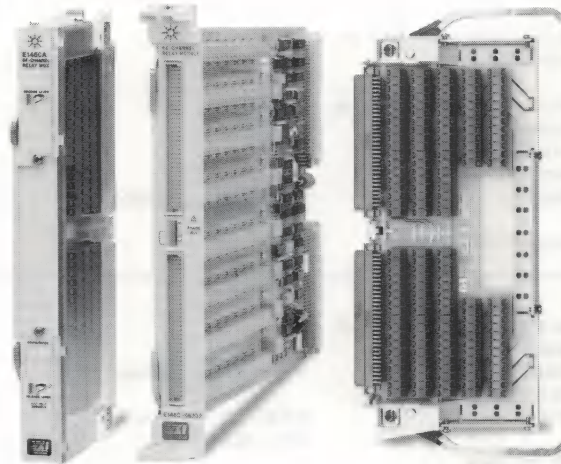


Signal Conditioning Components/Current Shunt

Publication No.: 5965-5603E

64-Channel High-Density Relay Multiplexer

Agilent E1460A



- 1-Slot, C-size, register based
- Armature latching relay channels
- Configuration for testing insulation
- Includes QUIC easy-to-use terminal block
- Numerous multiplexer topologies
- Configurable for scanning voltmeter applications

Description

The Agilent Technologies E1460A High-Density Relay Multiplexer is a C-size, 1-slot, register-based VXI module. This 64-channel multiplexer, using latching armature switches, offers a highly configurable, high point-count switching topology. Switching topologies include 64 two-wire, 32 three-wire, 32 four-wire, or 128 single-ended latching relay channels. This multiplexer consists of a component card with switches (labeled E1460-66202) and the QUIC screw terminal block (E1460-80011) that plugs onto the component card.

Use of SCPI commands or status bit jumpers on the terminal card configures the E1460A "wire mode" as either a 128x1-wire, 64x2-wire, 32x3-wire, or 32x4-wire multiplexer.

Applications for the E1460A include wire harness and cable testing, semiconductor testing, and printed circuit board testing.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

The switch consists of eight banks of eight Hi and Lo switches, each bank having its own eight Hi and Lo common. There are seven programmable control switches and six sets of wire jumpers. These wire jumpers allow all bank commons to produce either eight 1x8 two-wire multiplexers, four 1x8 two-wire multiplexers, and two 1x16 two-wire multiplexers, or four 1x16 two-wire multiplexers. Other switching topologies are also possible.

One 2.5-in analog bus cable (E1400-61605) is included to connect the analog buses of multiple slot-adjacent E1460A modules or a slot-adjacent E1411B multimeter module. The analog bus cable, easily installed at the faceplate of the component card, lets you connect the E1460A with the E1411B DMM. Using SCPI commands sent to the E1411B, you can close channels configured as two-wire, three-wire, or four-wire in the E1460A. It is possible (but less convenient) to connect the analog bus by attaching your own wiring to the E1460A and E1411B screw terminals.

The E1460A User Manual contains configuration and programming examples for one-wire through four-wire switching modes, cable test, switchbox, scanning, triggering, and scanning with an external multimeter.

(Agilent E1460A continued)

Product Specifications

Input

dc:	
Maximum voltage (any terminal to any other terminal or chassis):	220 Vdc
ac rms:	
Maximum voltage (any terminal to any other terminal or chassis):	250 V rms
Maximum current (per channel common, non-inductive):	1 Adc/ac rms (< 30 Vdc), 0.3 Adc/ac rms (<133 Vdc)
Maximum power per channel:	40 VA

dc

Maximum thermal offset per channel, differential Hi-Lo:	7 μ V
Closed channel resistance:	<1.5 Ω initial, <3.5 Ω end of life
Insulation resistance (between any two points):	5x10E6 Ω (40° C, 95% RH), 5x10E8 Ω (25° C, 40% RH)
Insulation resistance (Hi to Lo, power off):	n/a

ac

Minimum bandwidth (-3 dB, 50 Ω source/load):	10 MHz (2-wire), 3 MHz (1-wire)
Crosstalk (channel-to-channel):	
100 kHz:	\leq 60 dB (1-wire), \leq 90 dB (2-wire)
10 MHz:	n/a
Both:	n/a
Closed channel capacitance:	<650 pF Hi-Lo, <700 pF Lo-Chassis (both in 2-wire mode)

General Characteristics

Relays:	Latching armature Break-before-make
Power down state:	Relays open on power down
Power up state:	Relays open on power up
Minimum relay life:	
No load:	5x10E6 operations
Rated load:	10E5 operations
Screw terminal wire size:	16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)
Scanning rate:	75 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1, P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.02
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM}	I_{DM}
+5 V:	0.1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

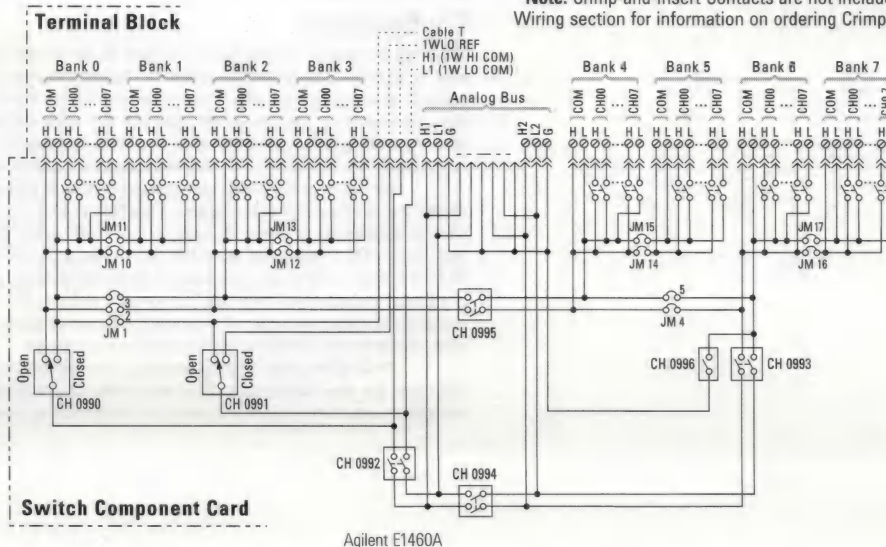
Cooling/Slot

Watts/slot:	5.00
ΔP mm H ₂ O:	0.08
Air Flow liter/s:	0.42

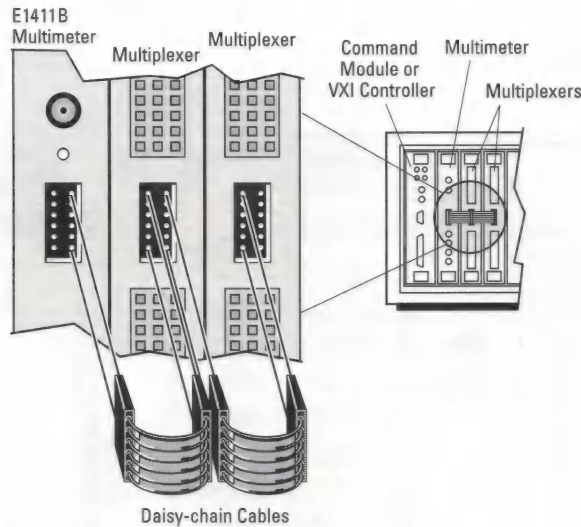
Ordering Information

Description	Product No.
64-Channel High-Density Relay Multiplexer	E1460A
Pre-QUIC-type Terminal Block	E1460A 106
Crimp-and-Insert Terminal Block*	E1460A A3E*
Service Manual	E1460A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1460A W01
Extra Screw Terminal Block	E1460-80011
Extra Crimp-and-Insert Terminal Block (if ordered separately)*	E1460-80012*

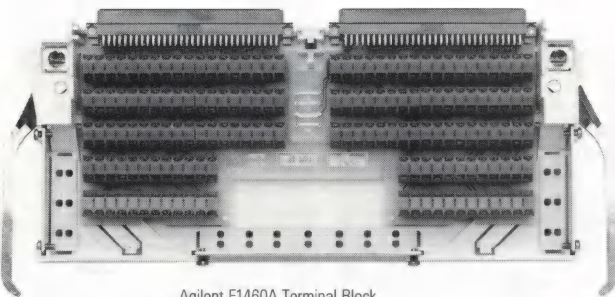
* Note: Crimp-and-Insert Contacts are not included. See the Interconnect and Wiring section for information on ordering Crimp-and-Insert Contacts.



(Agilent E1460A continued)



Agilent E1460A with MUX-to-MUX and MUX-to-multimeter analog bus cabling

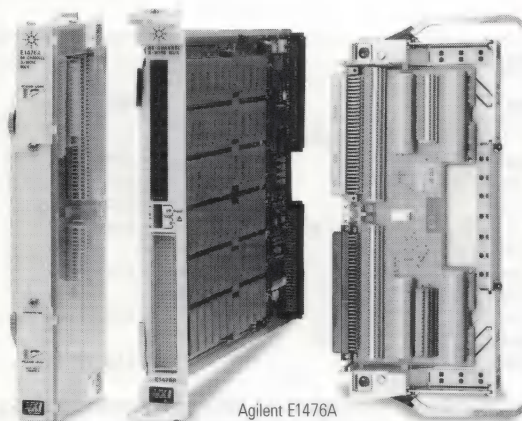


Agilent E1460A Terminal Block

Publication No.: 5965-5606E

64-Channel 3-Wire T/C Relay Multiplexer

Agilent E1476A



Agilent E1476A

- 1-Slot, C-size, register based
- Low-thermal offset relay $<2 \mu\text{V}$
- 64 channels of temperature with compensation
- 64 channels of voltage — 3-wire high, low, and guard
- 64 channels 2-wire and 32 channels 4-wire resistances
- Includes QUIC easy-to-use terminal block

Agilent Technologies

Description

The Agilent Technologies E1476A High-Density Reed Relay Multiplexer is a **C-size, 1-slot, register-based VXI module**. This low-offset, thermocouple compensated multiplexer is dynamically configurable providing 64 channels of two-, three- or four-wire (32 channels) of switching. This multiplexer module consists of a component card with switches and a QUIC spring clamp terminal block that plugs onto the component card. The E1476A is ideal for applications needing a relay multiplexer that is dynamically configurable, and makes maximum high-quality, high point-count measurements.

High-integrity voltage measurements are possible with three-wire high, low, and guard switching. In addition to making two-wire resistance and precision four-wire resistance measurements, you can make up to 64 channels of thermocouple temperature measurements with automatic cold junction compensation.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Temperature Measurements

The reference thermistor is also accessible by both banks, each bank having a control switch allowing for either a two-wire or four-wire resistance measurement of the 5000Ω reference thermistor mounted on the isothermal plane located in the terminal block. Using a scanning multimeter configuration, the channel relays and five control relays are programmed by SCPI commands or by register read/writes. SCPI command syntax to make a temperature scan of K type thermocouples is:

MEAS:TEMP? TC, K, (@100:163)

Configuration

Each of the 64 channels provides separate high, low, and guard connections, all easily accessible via the quick connect screwless terminals on the companion terminal block. The multiplexer is organized in two banks of 32 with each bank having its own voltage sense control switch and one bank having a current source control switch. This dual bank configuration makes it possible to use half the channels as sense channels, while the other half are used as current source channels, thus obtaining 32 four-wire measurement channels, each with high, low, and guard connections.

One 6 cm (2.5-in) analog bus cable (E1400-61605) is shipped with each module to allow you to interconnect the E1411B 5.5-digit multimeter to one or more E1476A multiplexers via its front panel analog bus connector. For connection to an external voltmeter or other VXI multimeter with conventional front panel connectors, access to the analog bus lines is available in the terminal block. This allows you to connect the analog bus signal lines to the multimeter inputs using ordinary hookup wire.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis): 120 Vdc

ac rms:

Maximum voltage (any terminal to any other terminal or chassis): 120 V rms

Maximum current (per channel common, non-inductive): 35 mA

Maximum power per channel: 4 VA

dc

Maximum thermal offset per channel,

differential Hi-Lo: $<4 \mu\text{V}$, $<2 \mu\text{V}$ (10 samples averaged)

Closed channel resistance: $100 \Omega \pm 5 \Omega$

Insulation resistance (between any two points): $10^9 \Omega$, 40°C , 95% RH

Insulation resistance (Hi to Lo, power off): n/a

ac

Minimum bandwidth (-3 dB , 50Ω source/load): 100 kHz

Crosstalk (channel-to-channel):

100 kHz: -70 dB

10 MHz: -45 dB

Both: n/a

Closed channel capacitance: $<175 \text{ pF}$ H-L, $<300 \text{ pF}$ L-G, $<1500 \text{ pF}$ G-G

(Agilent E1476A continued)

General Characteristics

Relays:	Reed relays Break-before-make
Power down state:	Relays open on power down
Power up state:	Relays open on power up
Minimum relay life:	
No load:	5x10E9 operations
Rated load:	10E7 operations
Reference junction measurement accuracy (18 to 28° C operating):	0.38° C
Strain gage excitation:	n/a
Screw terminal wire size:	22 to 26 AWG (0.5, 0.75, 0.9 mm)
Scanning rate:	333 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	C
Slots:	1
Connectors:	P1/2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

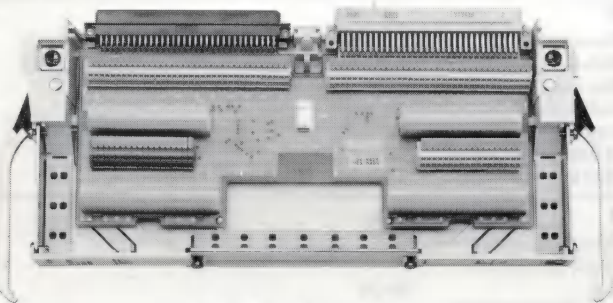
Command module firmware:	Downloadable
Command module firmware rev:	A.06
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

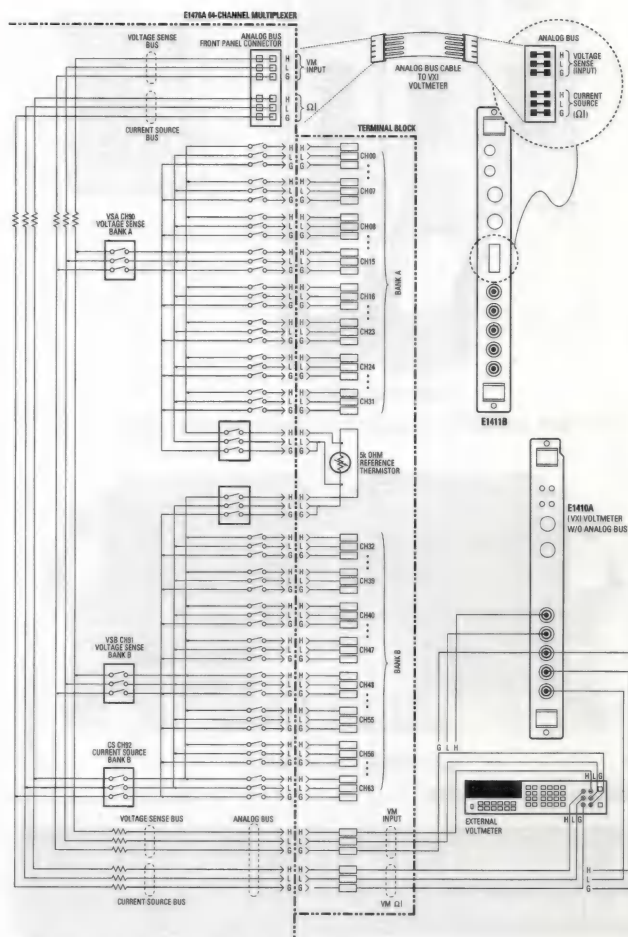
	I_{PM}	I_{DM}
+5 V:	0.1	0.1
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	4.00
ΔP mm H₂O:	0.10
Air Flow liter/s:	0.30



Agilent E1476A Terminal Block



Agilent E1476A Circuit Diagram

Ordering Information

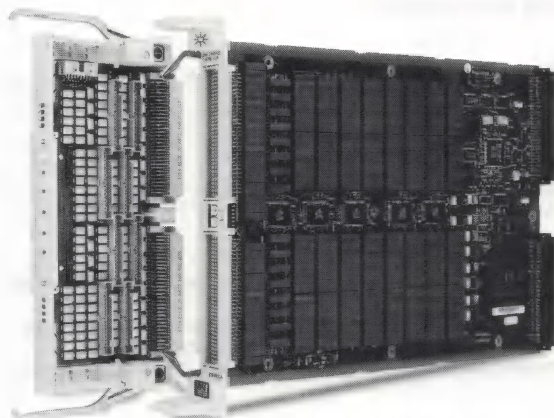
Description	Product No.
64-Channel 3-Wire T/C Relay Multiplexer	E1476A
Pre-QUIC-type Terminal Block	E1476A 106
Crimp-and-Insert Terminal Block **	E1476A A3E **
Service Manual	E1476A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1476A W01
Extra Pre-QUIC-type Terminal Block (if ordered separately)	E1476-80000
Extra QUIC-type Terminal Block (if ordered separately)	E1476-80010
Extra Crimp-and-Insert Terminal Block (if ordered separately) **	E1476-80011 **

** Crimp-and-Insert Contacts are not included. See the Interconnect and Wiring section for information on ordering Crimp-and-Insert Contacts.

Publication No.: 5965-5607E

256-Channel Reed Relay Multiplexer

Agilent E8460A



Agilent E8460A with Opt. 014

- 1-slot, C-size, register based
- High-density, low-cost multiplexer
- Fast scanning rate
- Flexible reconfiguration
- Contact protection for reliable operation
- Three different easy-to-use terminal blocks available as options

Description

The Agilent Technologies E8460A High-Density Reed Relay Multiplexer is a C-size, 1-slot, register-based VXI module. This 256-channel multiplexer, using reed relay switches, offers a fast, reconfigurable, high point-count switching topology. It is designed for applications requiring fast scanning rates by the use of fast action reed relays. This single-slot multiplexer extends the choices of multiplexers available to the system engineer.

The E8460A can be programmed into individual topologies; some common examples are shown in the table below. Many other combinations of these topologies are supported (in addition to those shown in the table). Two-wire, three-wire, and four-wire measurements can be configured.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Common Multiplexer Configurations

One 256 x 1	Four 64 x 1
One 128 x 2	Two 32 x 4
One 64 x 3	Sixteen 16 x 1
•	•
•	•
•	•

Accessories

A terminal block does not come with the module. Three different terminal blocks are available as options: one for crimp-and-insert connectors, one for ribbon cable connectors, and the other for fault-tolerant protection of DUT inputs, where each channel has a positive temperature coefficient resistor that behaves like a resettable fuse and will increase impedance when excessive current is flowing in a channel.

One 2.5-in. analog bus cable (E1400-61605) is included to connect the analog busses of multiple slot-adjacent E8460A modules or a slot-adjacent E1411B multimeter module. The analog bus cable, easily installed at the faceplate of the component card, lets you connect the E8460A with the E1411B DMM.

Product Specifications

Input

Note: These limits apply only if no connection is made to power mains.

Maximum Input

	With Opt. 012 Terminal Card	With Opt. 014 or Opt. 015 Terminal Card	Analog Bus
Maximum dc voltage:	200 V	60 V	60 V
Max. ACrms voltage:	140 V	50 V*	30 V
Max. ACpeak voltage:	200 V	70.7 V	42 V
Max. current per channel:			
Switching:	300 mA	100 mA	n/a
Carry:	500 mA	100 mA	n/a
Maximum power per channel:	5 VA		
Maximum power (resistive load):			
Per channel:	5 VA		
Per common output:	5 VA		
Per module:	60 VA		

*Rating reduced to 30 Vac-rms, 42 Vac-peak for exposed conductors.

dc Performance

Typical thermal offset (per channel):	± 50 μ V
Closed channel resistance:	<3 Ω with output protection resistor shorted, protection resistor adds 100 Ω

ac Performance

Bandwidth, 50 Ω Source/Load

Configuration	100 Ω Protection Resistor Shorted
256 x 1:	4.5 MHz
64 x 1:	12.0 MHz
16 x 1:	30.0 MHz

Closed Channel Capacitance

Configuration	To Chassis	To Open Channel
256 x 1:	1400 pF	70 pF
64 x 1:	460 pF	70 pF
16 x 1:	140 pF	70 pF

Open channel to either open channel or to chassis capacitance: 70 pF

Hi-to-Low Capacitance (2-Wire Mode)

Configuration	Capacitance
256 x 1:	400 pF
64 x 1:	230 pF
16 x 1:	80 pF

Crosstalk

Configuration	10 kHz	100 kHz	1 MHz	10 MHz
256 x 1 (channel to chassis):	-84 dB	-64 dB	-44 dB	-30 dB
64 x 1:	-84 dB	-64 dB	-44 dB	-27 dB
16 x 1:	-83 dB	-64 dB	-44 dB	-24 dB

(Agilent E8460A continued)

General Characteristics

Relays:	Reed relays
Open/close time:	0.5 ms max.
Minimum relay life:	
No load:	500 M operations
Rated load:	10 M operations (Max. rated resistive load)
Power up/down state:	All open

General Specifications**VXI Characteristics**

VXI device type:	Register based
Data transfer bus:	A16, slave only
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	1.7	0.4
+12 V:	0	0
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V:	0	0
-2 V:	0	0

Cooling/Slot

Watts/slot:	8.5
ΔP mm H ₂ O:	0.05
Air Flow liter/s:	0.7

Ordering Information

Description	Product No.
256-Channel Reed Relay Multiplexer	E8460A*
Crimp and Insert Connector Terminal Block	E8460A 012**
Fault Tolerant Terminal Block	E8460A 014***
Ribbon Cable Connector Terminal Block	E8460A 015***
Service Manual	E8460A 0B3
3 yr. retn. to Agilent to 1 yr. OnSite warr.	E8460A W01

Notes:

* Standard unit does not include terminal block. One of the terminal block options must be ordered.

** Crimp-and-Insert Contacts are not included. See the Interconnect and Wiring section for information on ordering Crimp-and-Insert Contacts.

*** Ribbon cables and mating connectors are not included. See ordering details below:

Recommended 3M Mating Socket and Cable

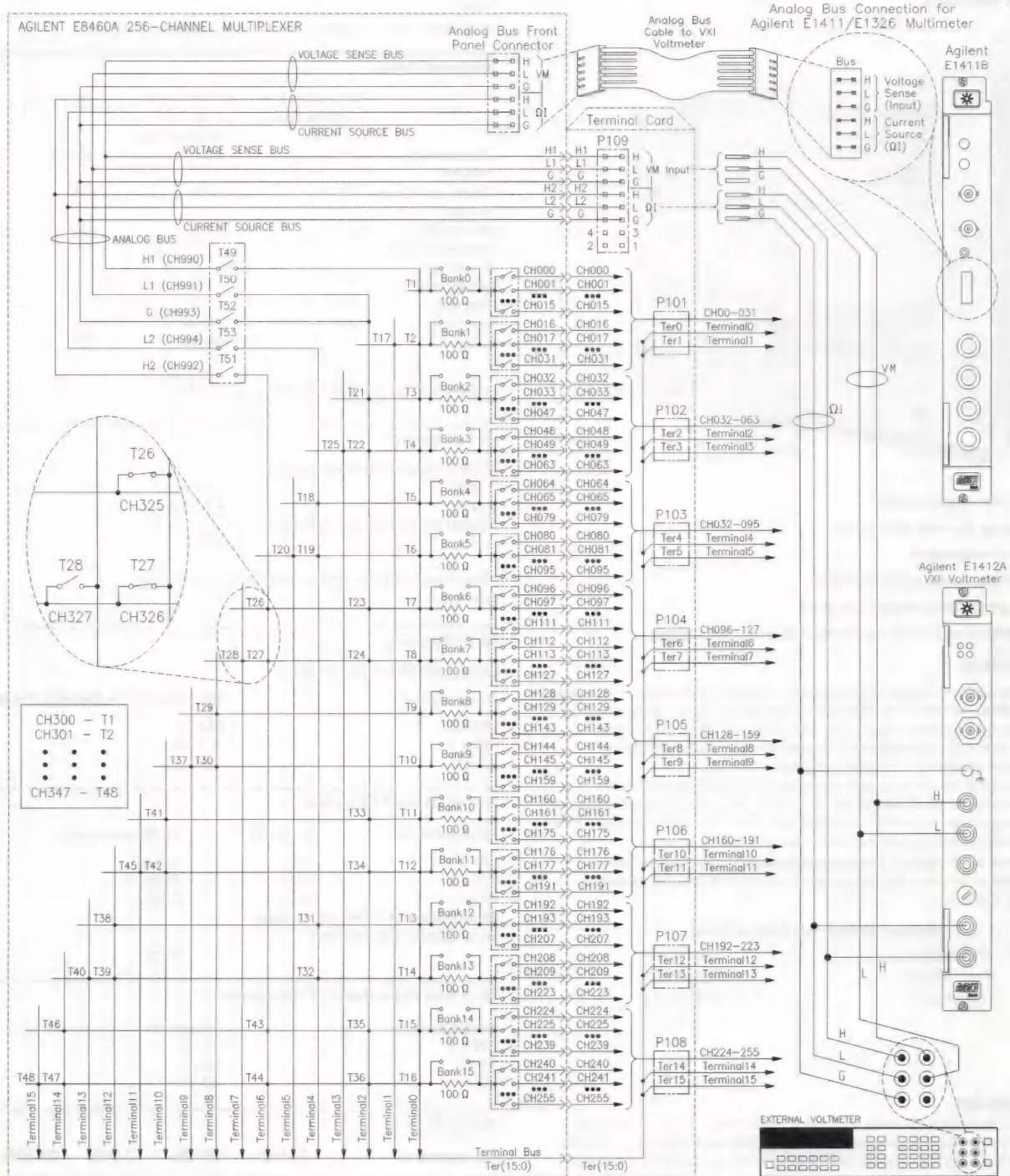
Part Description	Qty Required per Terminal Card	3M Part Number
Socket (without strain relief)	8 sockets either with or without strain relief	3414-6600
Socket * (with strain relief)	8 sockets either with or without strain relief	3414-6606
Metal strain relief *(low profile)	8 *	3448-2034
Flat cable (34 conductor)	Length as needed	3365/34

* Required only for socket with strain relief.

Manufacturer Ordering Information

3M Electronic Products Division
6801 River Place Blvd.
Austin, TX 78726-9000
Phone 800-225-5373

(Agilent E8460A continued)



Agilent E8460A Simplified Schematic

Publication No.: 5965-8829E

256-Channel Armature Relay Multiplexer

Agilent E8462A



- 1-Slot, C-size, register based
- High-density, low-cost multiplexer
- Flexible reconfiguration
- Armature non-latching relay channels
- Contact protection for reliable operation
- Three different easy-to-use terminal blocks available as options

Description

The Agilent Technologies E8462A High-Density Relay Multiplexer is a C-size, 1-slot, register-based VXI module. This 256-channel multiplexer, using non-latching armature relays, offers a fast, reconfigurable, high point-count switching topology. This single-slot multiplexer extends the choices of multiplexers available to the system engineer.

The E8462A can be programmed into individual topologies; some common examples are shown in the table below. Many other combinations of these topologies are supported (in addition to those shown in the table). Two-wire, three-wire, and four-wire measurements can be configured.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Common Multiplexer Configurations

One 256 x 1	Four 64 x 1
One 128 x 2	Two 32 x 4
One 64 x 3	Eight 32 x 1
•	•
•	•
•	•

Accessories

A terminal block does not come with the module. Three different terminal blocks are available as options: one for crimp-and-insert connectors, one for ribbon cable connectors, and the other for fault-tolerant protection of DUT inputs, where each channel has a positive temperature coefficient resistor that behaves like a resettable fuse and will increase impedance when excessive current is flowing in a channel.

One 2.5-in. analog bus cable (E1400-61605) is included to connect the analog buses of multiple slot-adjacent E8462A modules or a slot-adjacent E1411B multimeter module. The analog bus cable, easily installed at the faceplate of the component card, lets you connect the E8462A with the E1411B DMM.

Product Specifications

Input

Note: These limits apply only if no connection is made to power mains.

Maximum Input

	With Opt. 012 Terminal Card	With Opt. 014 or Opt. 015 Terminal Card	Analog Bus
Maximum dc voltage:	*250 V	60 V	60 V
Maximum ACrms voltage:	*250 V	50 V	30 V
Maximum ACpeak voltage:	350 V	70.7 V	42 V
Maximum current per channel:			
Switching:	2 A @ 30 V	100 mA	n/a
Carry:	2 A	100 mA	n/a

*Limited to 15,000 hours of voltage stress above 80 V.

dc Performance

Typical thermal offset per channel:

1-wire:	± 3 μ V
2-wire:	± 1.5 μ V

Typical closed channel resistance:

1-wire:	<0.9 Ω *
---------	-----------------

*With output protection resistor shorted; protection resistor adds 100 Ω .

ac Performance

Bandwidth, 50 Ω Source/Load

Configuration	100 Ω Protection Resistor Shorted
256 x 1:	6 MHz
128 x 1:	12.0 MHz
32 x 1:	30.0 MHz

Closed Channel Capacitance

Configuration	To Chassis	To Open Channel
256 x 1:	620 pF	410 pF
128 x 1:	340 pF	220 pF
32 x 1:	160 pF	100 pF
Open channel to either open channel or to chassis (capacitance):		30 pF

Hi-to-Low Capacitance (2-Wire-Mode)

Configuration	Capacitance
128 x 2:	410 pF
64 x 2:	230 pF
16 x 2:	100 pF

Crosstalk

Configuration	10 kHz	100 kHz	1 MHz	10 MHz
256 x 1 (1-wire):	70 dB	53 dB	33 dB	15 dB
128 x 1 (2-wire):	85 dB	65 dB	45 dB	30 dB
16 x 1 (2-wire):	85 dB	65 dB	45 dB	30 dB

(Agilent E8462A continued)

General Characteristics

Relays:	Armature relays
Open/close time:	5 ms max.
Minimum relay life:	
1.0 V & 10 mA:	1 M operations
Rated full resistive load (60 VA):	100 K operations
Power up/down state:	All open
Minimum permissible load:	10 m Vdc, 10 μ A

General Specifications**VXI Characteristics**

VXI device type:	Register based, A16/D16
Data transfer bus:	A16, slave only
Size:	C
Slots:	1
Connectors:	P1/P2
Shared memory:	None
VXI buses:	None

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.08
I-SCPI Win 3.1:	No
I-SCPI Series 700:	No
C-SCPI LynxOS:	No
C-SCPI Series 700:	No
Panel Drivers:	No
VXIplug&play Win Framework:	No
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I_{PM} (A)	I_{DM} (A)
+5 V:	*1.0	*0.5
+12 V:	0.0	0.0
-12 V:	0.0	0.0
+24 V:	—	—
-24 V:	—	—
-5.2 V:	—	—
-2 V:	—	—

* Specified in worst case typical MUX configuration (eight 32x1). Add 30 mA per additional relay.

Cooling/Slot

Watts/slot:	30 W max., 10 W typ.
ΔP mm H₂O:	0.1
Air Flow liter/s:	3.0

Ordering Information

Description	Product No.
256-Channel Armature Relay Multiplexer*	E8462A*
Crimp and Insert Connector Terminal Block**	E8462A 012**
Fault Tolerant Terminal Block	E8462A 014***
Ribbon Cable Connector Terminal Block	E8462A 015***
Service Manual	E8462A 0B3
3 yr. Retn. to Agilent to 1 yr. OnSite Warr.	E8462A W01

Notes:

* Standard unit does not include terminal block. One of the terminal block options must be ordered.

** Crimp-and-Insert Contacts are not included. See the Interconnect and Wiring section for information on ordering Crimp-and-Insert Contacts.

*** Ribbon cables and mating connectors are not included. See ordering details below:

Recommended 3M Mating Socket and Cable

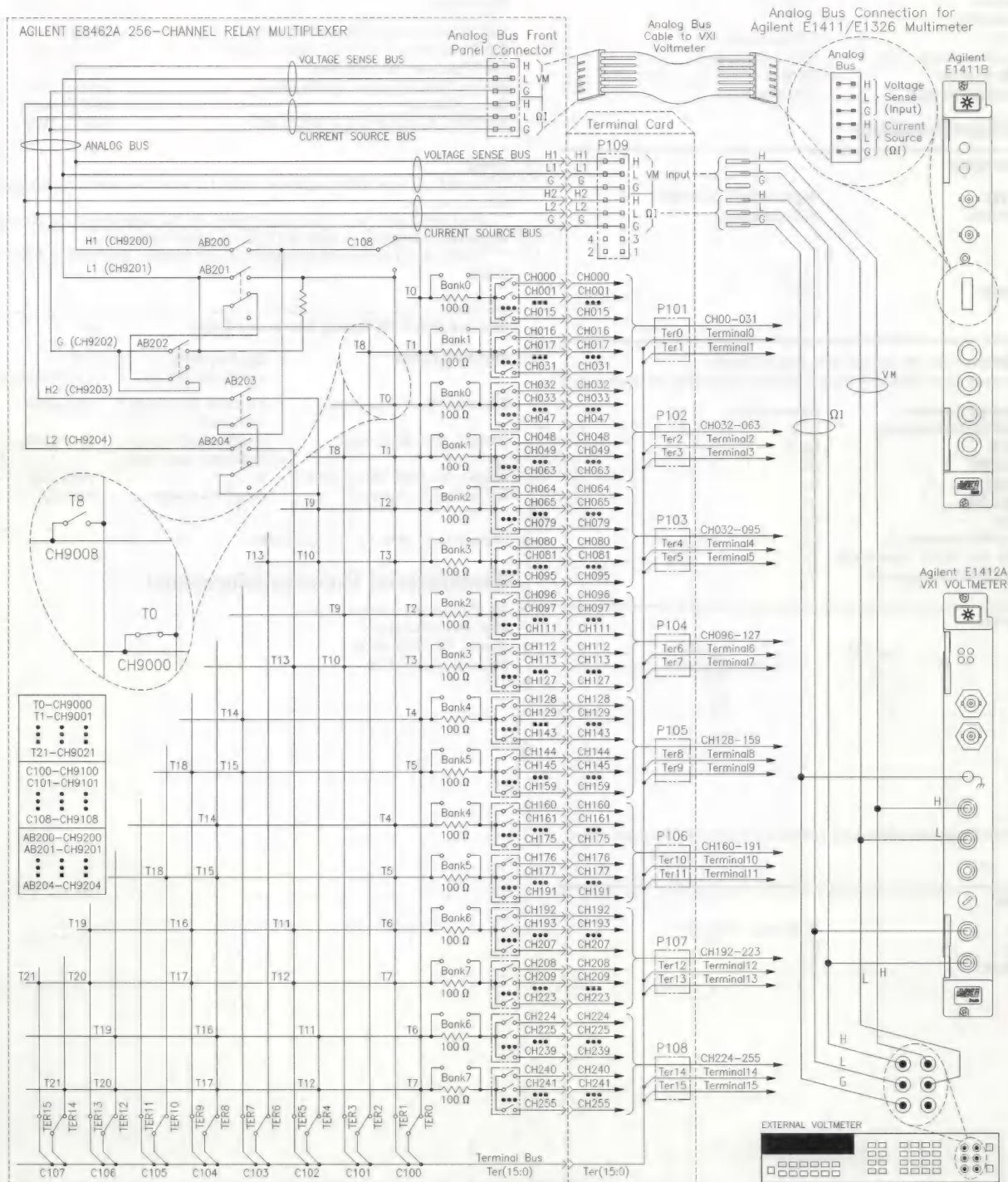
Part Description	Qty Required per Terminal Card	3M Part Number
Socket (without strain relief)	8 sockets either with or without strain relief	3414-6600
Socket * (with strain relief)	8 sockets either with or without strain relief	3414-6606
Metal strain relief *(low profile)	8 *	3448-2034
Flat cable (34 conductor)	Length as needed	3365/34

* Required only for socket with strain relief.

Manufacturer Ordering Information

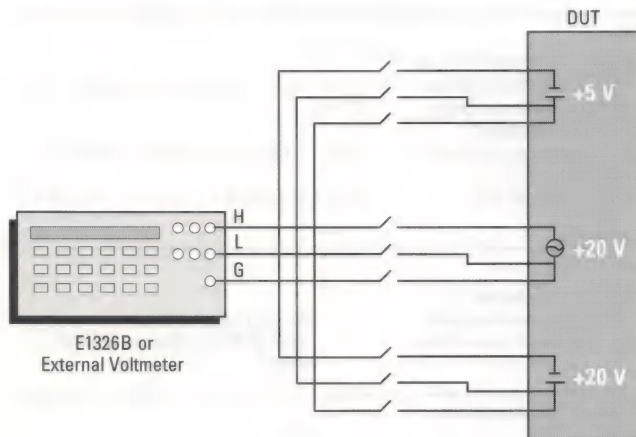
3M Electronic Products Division
6801 River Place Blvd.
Austin, TX 78726-9000
Phone 800-225-5373

(Agilent E8462A continued)



Agilent E8462A Simplified Schematic

Publication No.: 5966-2918E



B-Size VXI Modules

Product No.	Description
E1351A	16-Channel FET Multiplexer
E1352A	32-Channel Single-Ended FET Multiplexer
E1353A	16-Channel T/C FET Multiplexer

Introduction

A multiplexer connects one electrical point to another. The primary use of a FET (field effect transistor) multiplexer is to switch multiple analog signals at high speed to a measuring instrument, such as a voltmeter. Break-before-make operation ensures that no two signals are ever connected to each other during scanning operations. It is impossible to close multiple channels simultaneously on FET multiplexers.

FET switches, which are used on these multiplexers, are solid-state components required for various applications. Agilent Technologies' FET multiplexer switches deliver fast scanning rates and eliminate switch life problems compared to reed or armature relays.

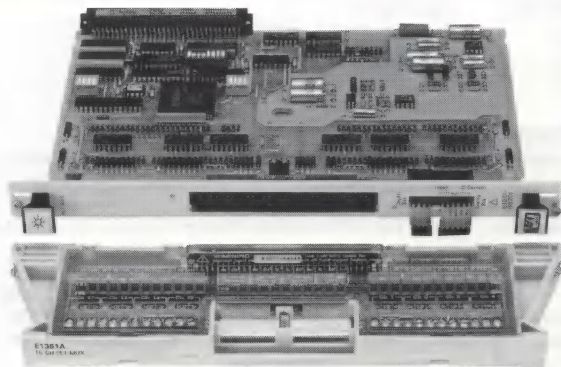
FET Multiplexer Choices

Agilent offers multiplexers with a wide variety of functionality to meet your test system needs. Agilent's FET multiplexers can switch 16 channels of high, low, and guard (E1351A), or 32 channels of high only and one low common input (E1352A). The E1353A FET multiplexer can switch 16 channels of high, low, and guard, as well as provide thermocouple compensation.

Model	E1351A	E1352A	E1353A
	16-Channel FET MUX	32-Channel Single-Ended FET MUX	16-Channel T/C FET MUX
Input			
Max. Vdc:	16 Vpk	16 Vpk	16 Vpk
Max. Vac rms:	16 Vpk	16 Vpk	16 Vpk
Max. current switching:	1 mA	1 mA	1 mA
dc			
Maximum thermal offset per channel, differential Hi-Lo:	250 μ V	250 μ V	250 μ V
Closed channel resistance:	<3.1 k Ω	<3.1 k Ω	<3.1 k Ω
ac			
Minimum bw (-3 dB, 50 Ω source/load):	500 kHz (1 M Ω 10 pF termination)	500 kHz (1 M Ω 10 pF termination)	500 kHz (1 M Ω 10 pF termination)
Closed channel capacitance:	<2000 pF Hi/Lo-Chassis <200 pF Hi-Lo	<2000 pF Hi/Lo-Chassis <200 pF Hi-Lo	<2000 pF Hi/Lo-Chassis <200 pF Hi-Lo
Reference junction measurement accuracy (18 to 28° C operating):	—	—	0.3° C
VXI Characteristics			
Size:	B	B	B
Slots:	1	1	1
VXI device type:	Register based	Register based	Register based
Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.			
VXIplug&play Win Framework:	Yes	No	Yes
VXIplug&play Win 95/NT Framework:	Yes	No	Yes
VXIplug&play HP-UX Framework:	No	No	No

16-Channel FET Multiplexer

Agilent E1351A



Agilent E1351A

- 1-Slot, B-size, register based
- Up to 13,000 channels/s scanning with Agilent's DMMs
- 100,000 switches/second from downloaded scan list
- Voltage, current, and resistance measurements
- Space for signal conditioning components

Description

The Agilent Technologies E1351A FET Multiplexer is a **B-size, 1-slot, register-based VXI module** that switches 16 channels each of high, low, and guard. The FET multiplexer module consists of a B-size component card (labeled E1351-66201 on each one) and a screw terminal block that plugs onto the component card. The E1351A is functionally similar to the E1352A and E1353A.

An analog bus connector on the faceplate provides easy connection to an E1326B DMM, E1411B DMM, and/or other slot-adjacent multiplexers. Common high, low, and guard signals are connected by tree switch to both the tree terminals on the terminal card and the analog bus connector.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Common high, low, and guard signals are connected by tree switch to both the tree terminals on the terminal card and the analog bus connector.

A digital bus cable is shipped with each module, which attaches to a digital bus connector on the faceplates and is used to synchronize scanned measurements up to 13,000/second with either the E1326B DMM or E1411B DMM. Use of this bus requires the SCPI command TRIGger:SOURce DBUS. To connect an external DMM to the FET multiplexer for high-speed scanning synchronization up to 100,000 switches/second, order the digital FET MUX-to-DMM cable below.

One analog bus cable is shipped with each module, making it easy to connect multiplexer common outputs together for slot-adjacent modules. If you are using a B-size mainframe, E1300B or E1301B, use the analog bus cable shipped with the E1326A DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1351A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis): 16 Vpk

ac rms:

Maximum voltage (any terminal to any other terminal or chassis): 16 Vpk

Maximum current (per channel common, non-inductive): 1 mA

dc

Maximum thermal offset per channel, differential Hi-Lo:	25 μ V (0 to 28° C), 250 μ V (28 to 55° C)
Closed channel resistance:	<3.1 k Ω
Insulation resistance (between any two points):	10E8 Ω , 10E3 Ω \pm 10% guard to chassis
Insulation resistance (Hi to Lo, power off):	>1 k Ω for Vin <14 V, >220 Ω for Vin >14 V

ac

Minimum bandwidth (–3 dB, 50 Ω source/load):	500 kHz (1 M Ω m 10 pF termination)
Closed channel capacitance:	<2000 pF Hi/Lo-Chassis, <200 pF Hi-Lo

General Characteristics

Relays:	FETs Break-before-make FETs open on power down FETs open on power up
Power down state:	
Power up state:	
Minimum relay life:	
No load:	Unlimited
Rated load:	Unlimited
Reference junction measurement accuracy (18 to 28° C operating):	n/a
Strain gage excitation:	n/a
Screw terminal wire size:	16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)
Scanning rate:	13,000 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:	Register based, A16, slave only
Size:	B
Slots:	1
Connectors:	P1
Shared memory:	None
VXI buses:	None
C-size compatibility:	Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:	Downloadable
Command module firmware rev:	A.03
I-SCPI Win 3.1:	Yes
I-SCPI Series 700:	Yes
C-SCPI LynxOS:	Yes
C-SCPI Series 700:	Yes
Panel Drivers:	Yes
VXIplug&play Win Framework:	Yes
VXIplug&play Win 95/NT Framework:	Yes
VXIplug&play HP-UX Framework:	No

Module Current

	I _{PM}	I _{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
–12 V:	0	0
+24 V:	0	0
–24 V:	0	0
–5.2 V:	0	0
–2 V:	0	0

Cooling/Slot

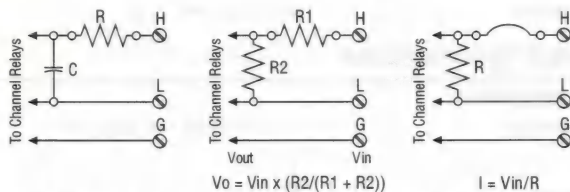
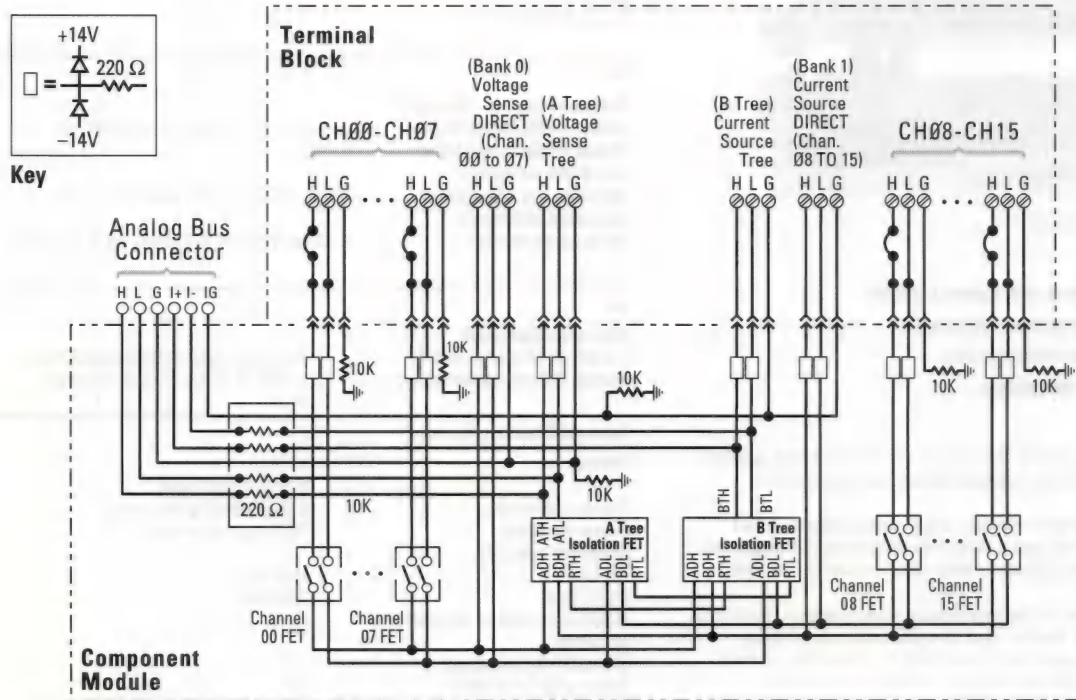
Watts/slot:	1.00
Δ P mm H ₂ O:	0.02
Air Flow liter/s:	0.10

(Agilent E1351A continued)

Ordering Information

Description	Product No.
16-Channel FET Multiplexer	E1351A
Service Manual	E1351A 0B3
3 Yr. Retr. to Agilent to 1 Yr. OnSite Warr.	E1351A W01
Terminal Card, 16-Chan FET Multiplexer	E1351-80001
Cable Kit, VM To B-Size FET Multiplexer	E1411-80001

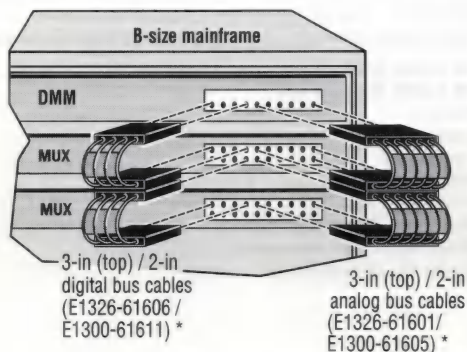
E1351A Circuit Diagram



Low Pass Filter Configuration
Analog and Digital Bus Cables for MUX-to-MUX and MUX-to-Multimeter Connections

Attenuator Configuration

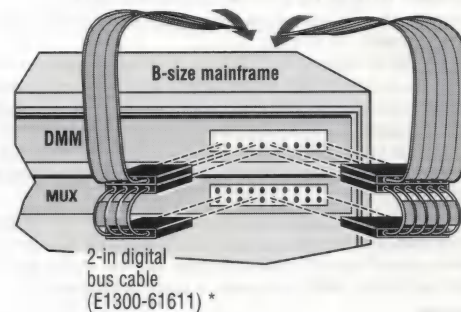
Current Sensing Configuration



Signal conditioning components and current shunt for E1351A/52A

19.5-in digital cable to internal multimeter (E1326-61608) **

19.5-in analog cable to internal multimeter (E1326-61611) **



* DMM-to-MUX and MUX-to-MUX analog and digital bus cables are provided with the purchase of the DMM and MUX modules, respectively.

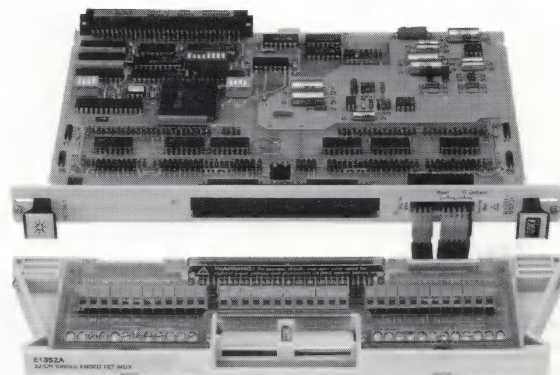
** 19.5-in analog and digital bus cable is provided with the purchase of E1300/01B Series B mainframe with internal DMM option.

Analog and Digital Bus Cables for MUX-to-MUX and MUX-to-Multimeter Connections

Publication No.: 5965-5586E

32-Channel Single-Ended FET Multiplexer

Agilent E1352A



Agilent E1352A

- 1-Slot, B-size, register based
- Up to 13,000 channels/s scanning with Agilent's DMMs
- 100,000 switches/second from downloaded scan list
- Voltage, current, and resistance measurements
- Space for signal conditioning components

Description

The Agilent Technologies E1352A FET Multiplexer is a B-size, 1-slot, register-based VXI module that switches 32 channels of high only and one low common input.

The FET multiplexer module consists of a B-size component card (labeled E1351-66201 on each one) and a screw terminal block that plugs onto the component card. The E1352A is functionally similar to the E1351A and E1353A.

An analog bus connector on the faceplate provides easy connection to an E1326B DMM, E1411B DMM, and/or other slot-adjacent multiplexers. Common high, low, and guard signals are connected by tree switch to both the tree terminals on the terminal card and the analog bus connector.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Common high, low, and guard signals are connected by tree switch to both the tree terminals on the terminal card and the analog bus connector. A factory-installed removable wire jumper on the component card connects the low input to the guard input.

A digital bus cable is shipped with each module, which attaches to a digital bus connector on the faceplates and is used to synchronize scanned measurements up to 13,000/second with either the E1326B DMM or E1411B DMM. Use of this bus requires the SCPI command TRIGger:SOURce DBUS. To connect an external DMM to the FET multiplexer for high-speed scanning synchronization up to 100,000 switches/second, order the digital FET MUX-to-DMM cable below.

One analog bus cable is shipped with each module, making it easy to connect multiplexer common outputs together for slot-adjacent modules. If you are using a B-size mainframe, E1300B or E1301B, use the analog bus cable shipped with the E1326A DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1352A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis): 16 Vpk

ac rms:

Maximum voltage (any terminal to any other terminal or chassis): 16 Vpk

Maximum current (per channel common, non-inductive): 1 mA

dc

Maximum thermal offset per channel, differential Hi-Lo:

25 μ V (0 to 28° C), 250 μ V (28 to 55° C)

Closed channel resistance:

<3.1 k Ω

Insulation resistance

(between any two points): 10E8 Ω , 10E3 Ω \pm 10% guard to chassis

Insulation resistance

(Hi to Lo, power off): >1 k Ω for |Vin| <14 V, >220 Ω for |Vin| >14 V

ac

Minimum bandwidth

(-3 dB, 50 Ω source/load): 500 kHz (1 M Ω || 10 pF termination)

Closed channel capacitance:

<2000 pF Hi/Lo-Chassis, <200 pF Hi-Lo

General Characteristics

Relays:

FETs
Break-before-make
FETs open on power down
FETs open on power up

Power down state:

Power up state:

Minimum relay life:

No load:

Unlimited

Rated load:

Unlimited

Reference junction measurement accuracy

n/a

(18 to 28° C operating):

Strain gage excitation:

n/a

Screw terminal wire size:

16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)

Scanning rate:

13,000 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:

Register based, A16, slave only

Size:

B

Slots:

1

Connectors:

P1

Shared memory:

None

VXI buses:

None

C-size compatibility:

Requires E1403C

Instrument Drivers - See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware:

Downloadable

Command module firmware rev:

A.03

I-SCPI Win 3.1:

Yes

I-SCPI Series 700:

Yes

C-SCPI LynxOS:

Yes

C-SCPI Series 700:

Yes

Panel Drivers:

Yes

VXIplug&play Win Framework:

No

VXIplug&play Win 95/NT Framework:

No

VXIplug&play HP-UX Framework:

No

(Agilent E1352A continued)

Module Current

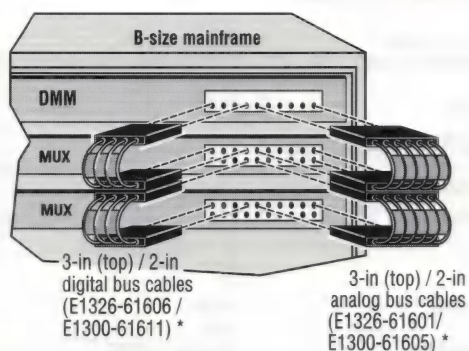
	I_{PM}	I_{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
-12 V:	0	0
+24 V:	0	0
-24 V:	0	0
-5.2 V	0	0
-2 V:	0	0

Cooling/Slot

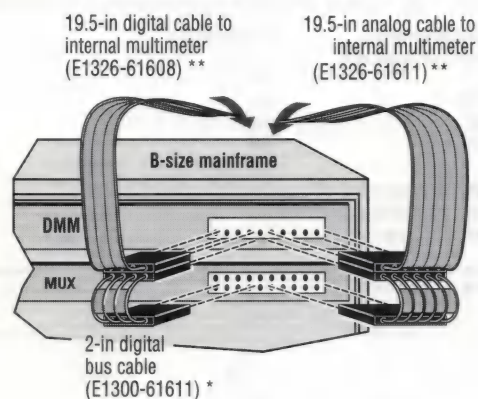
Watts/slot:	1.00
ΔP mm H ₂ O:	0.02
Air Flow liter/s:	0.10

Ordering Information

Description	Product No.
32-Channel Single-ended FET Multiplexer	E1352A
Service Manual	E1352A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1352A W01
Terminal Card, 16-Chan FET Multiplexer	E1352-80001
Cable Kit, VM To B-Size FET Multiplexer	E1411-80001



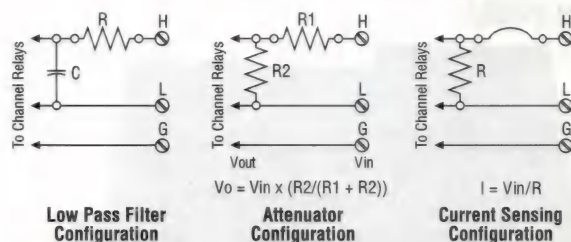
Analog and Digital Bus Cables for MUX-to-MUX and MUX-to-Multimeter Connections



* DMM-to-MUX and MUX-to-MUX analog and digital bus cables are provided with the purchase of the DMM and MUX modules, respectively.

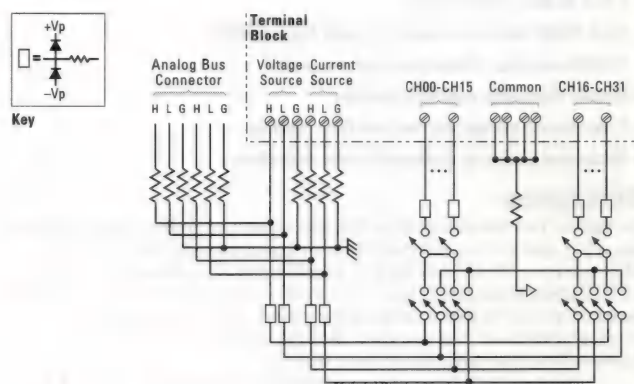
** 19.5-in analog and digital bus cable is provided with the purchase of E1300/01B Series B mainframe with internal DMM option.

Analog and Digital Bus Cables for MUX-to-MUX and MUX-to-Multimeter Connections



Signal conditioning components and current shunt for E1351A/52A

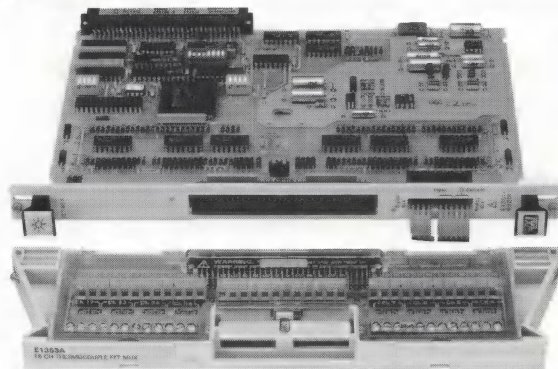
E1352A Circuit Diagram



Publication No.: 5965-5520E

16-Channel T/C FET Multiplexer

Agilent E1353A



Agilent E1353A

- 1-Slot, B-size, register based
- Up to 13,000 channels/s scanning with Agilent DMMs
- 100,000 switches/s from downloaded scan list
- Built-in thermistor reference junction
- Temperature, voltage, current, and Ohm readings
- 16-channel 3-wire, or 8-channel 4-wire multiplexer

Description

The Agilent Technologies E1353A FET Multiplexer is a B-size, 1-slot, register-based VXI module that switches 16 channels each of high, low, and guard. When used with the E1326B DMM or E1411B DMM, it makes automatically compensated thermocouple temperature measurements. The FET multiplexer module consists of a B-size component card (labeled E1351-66201) and a screw terminal block that plugs onto the component card. The E1353A is functionally similar to the E1351A and E1352A.

Common high, low, and guard signals are connected by tree switch to both the tree terminals on the terminal card and the analog bus connector. A digital bus cable is shipped with each module. It attaches to a digital bus connector on the faceplates, and is used to synchronize scanned measurements up to 13,000/s with the Agilent DMMs. Additionally, shunt and series signal conditioning elements can be added to each channel.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Configuration

Common high, low, and guard signals are connected by tree switch to both the tree terminals on the terminal card and the analog bus connector.

A digital bus cable is shipped with each module, which attaches to a digital bus connector on the faceplates and is used to synchronize scanned measurements up to 13,000/second with either the E1326B DMM or E1411B DMM. Use of this bus requires the SCPI command TRIGger:SOURce DBUS. To connect an external DMM to the FET multiplexer for high-speed scanning synchronization up to 100,000 switches/second, order the digital FET MUX-to-DMM cable below.

One analog bus cable is shipped with each module, making it easy to connect multiplexer common outputs together for slot-adjacent modules. If you are using a B-size mainframe, E1300B or E1301B, use the analog bus cable shipped with the E1326A DMM to connect it to the multiplexer(s).

C-size Adapter

For installing the E1353A in a C-size mainframe, the E1403C active adapter is recommended.

Product Specifications

Input

dc:

Maximum voltage (any terminal to any other terminal or chassis): 16 Vpk

ac rms:

Maximum voltage (any terminal to any other terminal or chassis): 16 Vpk

Maximum current (per channel common, non-inductive): 1 mA

dc

Maximum thermal offset per channel, differential Hi-Lo:

25 μ V (0 to 28° C), 250 μ V (28 to 55° C)

Closed channel resistance:

<3.1 k Ω

Insulation resistance

(between any two points):

10E8 Ω , 10E3 Ω \pm 10% guard to chassis

Insulation resistance

(Hi to Lo, power off):

>1 k Ω for |Vin| <14 V, >220 Ω for |Vin| >14 V

ac

Minimum bandwidth (–3 dB, 50 Ω

source/load):

500 kHz (1 M Ω || 10 pF termination)

Closed channel capacitance:

<2000 pF Hi/Lo-Chassis, <200 pF Hi-Lo

General Characteristics

Relays:

FETs

Break-before-make

FETs open on power down

FETs open on power up

Power down state:

Power up state:

Minimum relay life:

No load:

Unlimited

Rated load:

Unlimited

Reference junction measurement

accuracy

(18 to 28° C operating):

0.3° C

Screw terminal wire size:

16 to 26 AWG (1.5, 1.2, 0.9, 0.75, 0.5 mm)

Scanning rate:

13,000 channels/s typ.

General Specifications

VXI Characteristics

VXI device type:

Register based, A16, slave only

Size:

B

Slots:

1

Connectors:

P1

Shared memory:

None

VXI buses:

None

C-size compatibility:

Requires E1403C

Instrument Drivers - See the Agilent Technologies Website

(http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: Downloadable

Command module firmware rev: A.03

I-SCPI Win 3.1: Yes

I-SCPI Series 700: Yes

C-SCPI LynxOS: Yes

C-SCPI Series 700: Yes

Panel Drivers: Yes

VXIplug&play Win Framework: Yes

VXIplug&play Win 95/NT Framework: Yes

VXIplug&play HP-UX Framework: No

Module Current

	I _{PM}	I _{DM}
+5 V:	0.2	0.01
+12 V:	0.13	0.01
–12 V:	0	0
+24 V:	0	0
–24 V:	0	0
–5.2 V	0	0
–2 V:	0	0

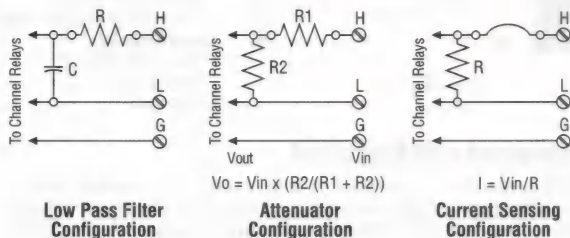
Cooling/Slot

Watts/slot:	1.00
Δ P mm H ₂ O:	0.02
Air Flow liter/s:	0.10

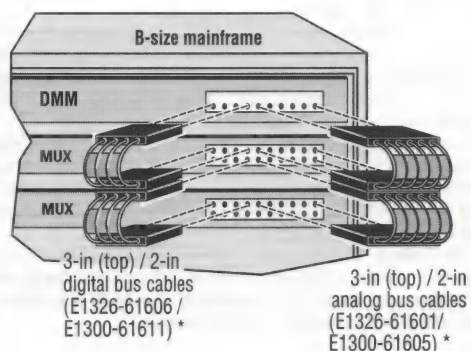
(Agilent E1353A continued)

Ordering Information

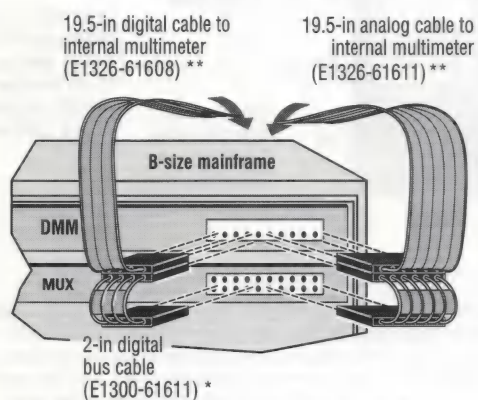
Description	Product No.
16-Channel T/C FET Multiplexer	E1353A
Service Manual	E1353A 0B3
3 Yr. Retn. to Agilent to 1 Yr. OnSite Warr.	E1353A W01
Terminal Card, 16-Chan FET Multiplexer	E1353-80001
Cable Kit, VM To B-Size FET Multiplexer	E1411-80001



Signal conditioning components and current shunt for E1353A



Analog and Digital Bus Cables for MUX-to-MUX and MUX-to-Multimeter Connections



* DMM-to-MUX and MUX-to-MUX analog and digital bus cables are provided with the purchase of the DMM and MUX modules, respectively.

** 19.5-in analog and digital bus cable is provided with the purchase of E1300/01B Series B mainframe with internal DMM option.

Analog and Digital Bus Cables for MUX-to-MUX and MUX-to-Multimeter Connections

Publication No.: 5965-5767E

VXI Tutorial

History

In 1987, a consortium of test and measurement companies introduced VXIbus, a new standard instrument architecture. VXIbus was developed to meet the needs for portable applications and to provide a standard modular architecture for integrating into the traditional GPIB test system and for standalone applications.

Description

Compact size, high throughput, and flexibility best characterize VXIbus. Today, you can use VXI to build a variety of test systems, from portable testers for field use and remote data acquisition applications to high-performance data acquisition and functional test systems. While some systems are entirely VXI, many users are integrating VXI along with traditional GPIB instruments. Dedicated measurement solutions using VXI virtual instruments now are possible with a growing industry-wide offering of products.

VXIbus is defined around the highly popular VMEbus architecture, known for its excellent computer backplane. High-speed data rates of 40 MB/s along with the necessary communication protocols make it ideal for building instrument systems for high throughput. VXIbus incorporates the ease-of-use features of intelligent GPIB instruments (for example, ASCII-level programming) into its message-based devices. It also takes advantage of the high throughput capability of VME devices, which are programmed and communicate directly in binary. The analog to these VME devices is the VXI register-based device. See Figure 1.

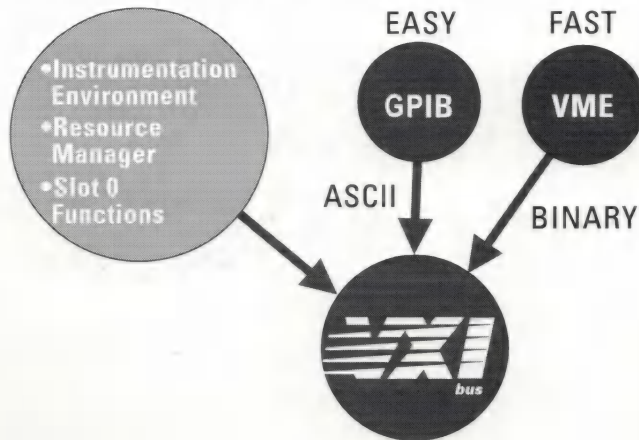
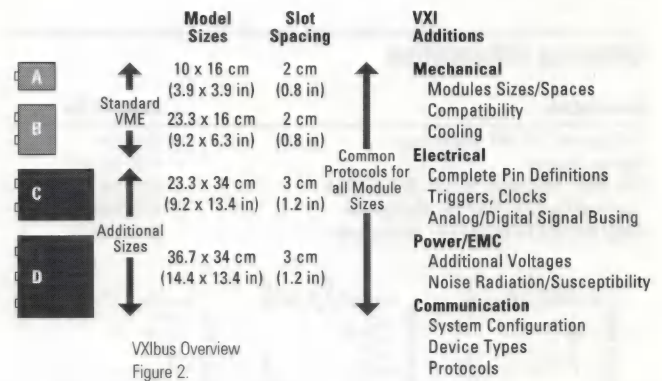


Figure 1.

Although VME is an excellent computer backplane, it is not adequate for instrumentation without further standardization. The VXIbus Consortium fully defined the operating environment for instrumentation modules. All VXIbus mainframes must state how much power and cooling they provide. And all VXI modules must state how much power and cooling they require. Also, there are strict limits on how much conducted and radiated interference is allowed between modules. These parameters allow you to easily configure a workable system.

Two special functions must be performed in every VXIbus system. The first, Slot 0, takes care of backplane management. Slot 0 is a unique physical location in every VXIbus mainframe. Signals from this slot must include things such as clock sources, arbitration for data movement across the backplane, etc. The module that goes into this slot must perform these hardware functions in addition to its normal functions. The Slot 0 device relieves you of the burden of managing data flow across the backplane.

The second special function in a VXIbus system is the Resource Manager. The best way to think of the Resource Manager is as a computer program. This program configures the modules for proper operation whenever the system is powered on or reset. This means that you can build the test system software from a known starting point. The Resource Manager is not involved with the VXIbus system once normal operation begins.



VXIbus Overview
Figure 2.

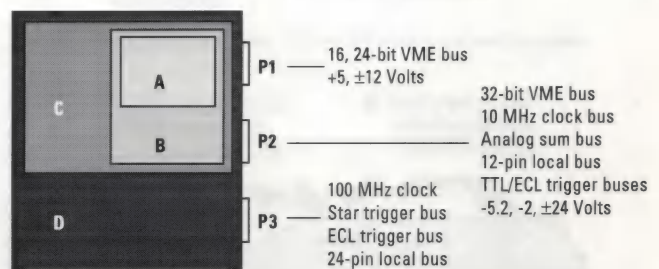
Mechanical and Electrical

The VXIbus specification defines a scaleable family of four module sizes as shown in Figure 2. The two smaller sizes, A and B, are the defined VMEbus module sizes and are true VMEbus modules in every sense of the word. The two larger sizes, C- and D-size, are additional sizes to allow higher performance instrumentation. Increased module spacing in the C- and D-size systems makes it possible to fully shield sensitive circuits for high-performance measurements. VXIbus is a scaleable architecture and allows smaller module sizes to fit into larger mainframes.

Other resources are provided for instrumentation. These include additional power supply voltages for powering analog and ECL circuits and instrumentation buses for measurement synchronization and triggering. Included are an analog sum bus and a set of local bus lines for private module-to-module communication.

A more standardized set of communication protocols were developed for VXIbus to handle autoconfiguration, resource management, and device communication. In addition, stringent EMC and noise requirements are specified to prevent any module from radiating enough energy into another module to affect its performance.

The VXIbus specifies three 96-pin DIN connectors called P1, P2, and P3 as shown in Figure 3. The P1 connector, the only mandatory connector in VME or VXIbus, carries the data transfer bus (up to 24 bits addressing and 16 bits data), the interrupt buses, and some power.



VXIbus Connectors
Figure 3.

P2

The optional P2 connector, available to all card sizes except A-size, expands the data transfer bus to its full 32-bit size. It also adds many resources: four additional power supply voltages, the local bus, the module identification bus (allows a VXIbus module's slot number to be determined), and the analog summing bus (a current summing bus that runs the length of the backplane). In addition, there are TTL and ECL trigger buses (running the length of the backplane with four trigger protocols defined) and a 10 MHz differential ECL clock signal (buffered to each slot).

P3

The optional P3 connector, available only on D-size, expands P2 resources for specialized applications. P3 provides 24 more local bus lines, additional ECL Trigger lines, and 100 MHz clock and star trigger lines for precision synchronization.

If a VXIbus mainframe supports the VXIbus P2 or P3 connector extensions, the Slot 0 module located in the leftmost slot may provide clock and trigger signals for synchronizing and initiating measurements. The Slot 0 module may also manage bus communication and can provide an IEEE-488 interface to allow control from an external controller. Such a module may be known as a Command Module, GPIB interface, or Resource Manager module.

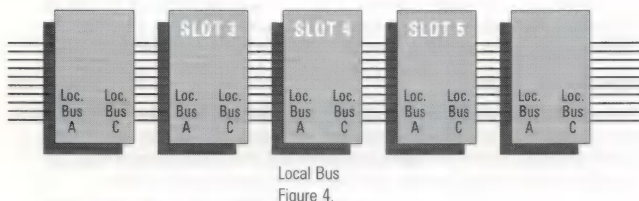
(VXI Tutorial continued)

Local Bus

The Local Bus adds significant capability to VXIbus measurement systems. It is a very flexible daisy-chain bus structure and is shown in Figure 4. In essence, every inner slot in a VXIbus mainframe has a set of very short 50 Ω transmission lines running between adjacent slots on either side. The local bus is 12 lines wide each direction through the P2 connector and an additional 24 lines wide through the P3 connector. This bus allows for adjacent modules to perform private communication; a scanner module multiplexing a number of analog nodes to the input of a digital multimeter is an example.

The VXIbus specification defines five signal classes for the local bus. Figure 5 shows that this bus can be used for TTL level signals, ECL level signals, or three analog levels.

To protect a module from damage caused by the user inadvertently inserting it into the wrong slot, every module using the local bus is keyed. Located on the top of the module's faceplate for the P2 local bus, and on the bottom for the P3 local bus, these mechanical keys prevent two modules from fitting next to each other unless they are compatible. In the example shown in Figure 6, these three modules can be inserted side by side. But if the position of two of them are reversed, they would no longer fit together. Each side and each classification is keyed.



Local Bus Signal Classes

Figure 5.

#	Class	+ Limit	- Limit	Drive Limit
1	TTL	+ 5.5 V	-0.5 V	200 mA
2	ECL	0.0 V	-5.46 V	50 mA
3	Analog Low	+ 5.5 V	-5.5 V	50 Ω drive
4	Analog Med.	+ 16.0 V	+ 16.0 V	500 mA
5	Analog Hi	+ 42.0 V	-42.0 V	500 mA
6	Reserved			

Local Bus Keys

Figure 6.

	TTL	TTL	ECL	ECL	Analog Low	Analog Low	Analog Med	Analog Med	Analog Hi	Analog Hi	RSVD	RSVD	No LBus	No LBus	Sensor ± 16 V	Sensor ± 16 V	Sensor ± 42 V	Sensor ± 42 V
Key	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
0	X	-	-	X	X	-	X	X	-	X	-	X	-	-	X	-	-	-
1	X	-	-	X	-	X	-	-	X	-	X	-	-	-	-	X	-	-
2	-	X	X	-	X	-	-	X	-	X	X	-	-	-	-	-	-	-
3	-	X	X	-	-	X	X	-	X	-	-	X	-	-	-	-	-	-

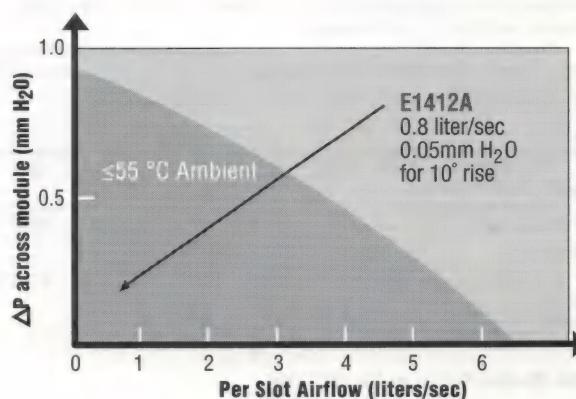
EMC

In addition, the VXIbus specifies radiated and conducted EMC limits for both generation and susceptibility. The importance of this part of the VXIbus specification cannot be overstated. EMC limits ensure that modules containing sensitive electronic circuits perform to expectations without interference from any other module operating in the system.

Cooling

In a typical IEEE-488 rack & stack system, the system integrator must take a rigorous approach to ensure an environment cool enough for proper operation. Each instrument's power dissipation, airflow, and placement in the rack must be considered. The rack's cooling capability must be factored in as well.

To ensure adequate cooling in a VXIbus system, the design process is simpler. Every vendor's mainframe specification sheet provides a graph like the one shown in Figure 7. This is how the Agilent E1401B C-Size Mainframe is specified to provide cooling capability in the worst-case module configuration. It is specified in terms of pressure across the module versus the airflow delivered. Figure 7 includes an example of the cooling requirements of the Agilent E1412A 6.5-digit multimeter mapped to the mainframe's cooling specification. The point, a plot of the module's airflow and back pressure specifications, is located within the boundaries of the curve; therefore, the module is guaranteed to be compatible with the mainframe. If the point is not located under the curve, then cooling may not be adequate. Additional analysis or derating of the maximum operating temperature may be required to insure reliable operation.⁽¹⁾



Cooling Specifications: Minimum Airflow per Slot for the Agilent E1401B
Figure 7.

(1) Procedure for derating the maximum operating temperature:

1. Plot the module specification point onto the mainframe specification curve.
2. The relationship between pressure drop and airflow for most modules is approximately linear. Draw a straight line through the origin and the module specification point.
3. The intersection between the straight line and the mainframe curve is the actual operating point of the module in that particular mainframe. Read the actual airflow of this point from the horizontal axis of the plot.
4. Compare the actual airflow with the module specification to estimate the temperature rise across the module: Actual Temperature Rise = Specified Temperature Rise x Specified Airflow/Actual Airflow.
5. Derate the maximum operating temperature by the amount that actual temperature rise exceeds specified temperature rise.

(VXI Tutorial continued)

Power

The power specification is another way that VXIbus makes the system integrator's job easier. Figure 8 shows how a VXIbus mainframe is specified for power delivered. Each power supply level has a peak dc current delivery and peak-to-peak dynamic current delivery. When selecting modules, voltage levels and current requirements are compared to the mainframe's capability. What is the significance of the peak dynamic current specification? An example illustrates this next. Modular instruments share common power supply voltages. As long as those modules draw steadily from the power supply, there is no problem and no need for dynamic current specifications. But some modules change their current requirements regularly. Refer to the relay module example in Figure 9.

While the relay's coil is energized, the module is drawing current from the supply. But when the coil is de-energized, the module's demand for current drops to zero. If the relay is being driven at 100 Hz rate, then the module has a dynamic current need on the order of that frequency.

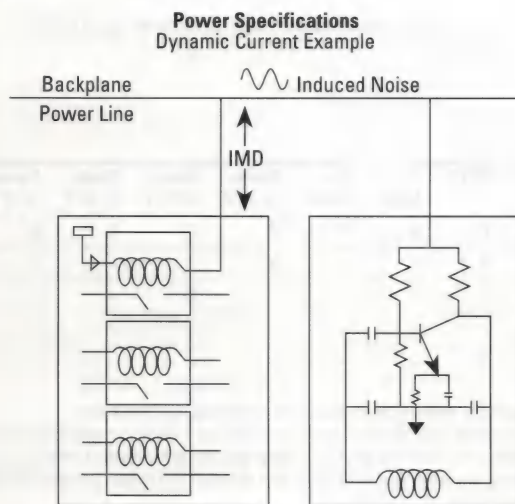
However, power supplies vary in their ability to deliver a steady voltage in the face of suddenly changing current requirements. If the power supply has a large inductive output (common in switching supplies), then its voltage output will vary in response to the dynamic current the relay module is requiring. This induced noise is seen by another module using the same supply and may affect its performance.

Therefore, the VXIbus dynamic current specification ensures that the selected modules will not induce more ripple noise on the mainframe's power supply lines than any module is required to withstand.

Figure 8.

dc Output	+ 5 V	+ 12 V	-12 V	+ 24 V	-24 V	-5.2 V	-2 V
Peak dc Current	60 A	12 A	12 A	12 A	10 A	60 A	30 A
P-P Dynamic Current	9.0 A	2.5 A	2.5 A	5.0 A	5.0 A	8.5 A	4.5 A

75 Watts Maximum Cooling per Slot (15° C rise)



Power Specifications
Dynamic Current Example
Figure 9.

Communications

Communications is another area of VXIbus standardization. VXIbus specifies several device types and protocols as well as communication handshakes. It also defines a system configuration entity called the Resource Manager. First, consider the VXIbus device types.

VXIbus Device Types

A VXIbus device is a component of a VXIbus system. There is one logical address per device (numbered from 0 to 255) and up to 256 devices in a VXIbus system. Typically a voltmeter, counter, or signal generator is each a single device. However, a VXIbus device is not necessarily limited to one slot; it can occupy several. The VXIbus specification also allows for several devices per slot.

There are four types of VXIbus devices: register-based, message-based, memory, and extended. The two most common types, register- and message-based, are described in this tutorial.

Communication protocols have several levels within VXIbus. One, the most basic level, communication is handled through register-level reads and writes. This is the level of communication defined by VMEbus. Communication on this level is very fast, and it is the least expensive protocol to implement in hardware.

Register-Based Device

A register-based device is the simplest VXIbus device and most often is used as the basis for simple instrument and switch modules. A register-based device communicates only through register reads and writes. Configuration is controlled by VXIbus-defined configuration elements but programmed through device-dependent registers. It is often controlled by an intelligent message-based device, its commander, that interprets ASCII instrument commands so it can be controlled exactly like a message-based device.

Message-Based Device

A message-based device is typically the most intelligent device of a VXIbus system. High-performance instruments are typically available as message-based devices. Besides the basic configuration registers supported by the register-based device type, the message-based device has common communication elements and a Word Serial Protocol to allow ASCII-level communication with other message-based modules. This allows easier multimanufacturer support, though at some sacrifice in speed to interpret the ASCII messages. Typically a message-based device uses a microprocessor and is more costly than a register-based device. Since the Word Serial Protocol mandates only a byte transfer per transition, which then must be interpreted by the on-board microprocessor, message-based devices are typically limited to IEEE-488 speeds. However, optional register-based access may be included on the module to bypass this bottleneck.

An IEEE-488-to-VXIbus interface is also defined in the VXIbus specification. It describes the routing of messages from an IEEE-488 bus to the VXIbus. This is a specific message-based device that translates IEEE-488 messages into VXIbus Word Serial Protocol for interpretation by the embedded message-based instrument.

VXIbus configuration is straightforward. Located at VXIbus logical address 0, the Resource Manager, a message-based commander, takes care of the configuration tasks. It sets up the shared address space, manages the system self-test, creates the commander-servant hierarchies, and then releases the system for operation fully configured. The following lists the operations of the Resource Manager at power-up for a message-based commander at logical address 0 that:

1. Identifies all VXI devices in system
2. Configures all resources necessary for its own operation
3. Manages system self-test
4. Configures system's A24 & A32 maps
5. Configures commander/servant hierarchies
6. Initiates normal operation

VXIbus Addressing

The VXIbus describes three addressing techniques an IEEE-488-to-VXIbus interface device may adopt, all compatible with any VXIbus message-based instrument. These are IEEE-488 primary addressing, IEEE-488 secondary addressing, and embedded addressing protocols.

With IEEE-488 primary addressing, each VXIbus instrument appears to the host controller as a unique IEEE-488 instrument with its own unique IEEE-488 address, commands and responses, status byte, and state storage. For all intents and purposes, it is a separate IEEE-488 instrument. Any software packages, tools, or drivers made to work with IEEE-488 instruments will also work with their VXIbus equivalents virtually unmodified, with perhaps only a change of address required.

(VXI Tutorial continued)

IEEE-488 secondary addressing is similar but uses the IEEE-488 secondary addressing capability instead of primary addresses. Typically, an IEEE-488-to-VXIbus interface device will respond to one primary address but map each associated secondary address to a unique VXIbus instrument. As with primary addressing, secondary addressing retains the compatibility with IEEE-488 applications while expanding the number of addressable VXIbus devices from 30 to over 900. This allows adequate addressing in multiple-chassis systems. An additional benefit is that once the primary address has been set on the VXIbus interface module, there will not be primary address conflicts between IEEE-488 instruments and additional VXIbus devices. This aids system integration and promotes an expandable migration path for a particular test system. Last, standard IEEE-488 interface chips today are designed to allow handling of multiple secondary addressing in a high-performance manner.

With VXIbus embedded addressing, a single primary address can represent the entire chassis, and a textual string embedded in the message identifies the intended recipient of the message. This technique allows the addressing of instruments over RS-232 or other links that do not have an addressing protocol of their own. However, embedded addressing has a serious performance and compatibility disadvantage if used in IEEE-488 systems. Embedded string addressing requires the interface module in the VXIbus chassis to internally store each command string, check for overall proper syntax, and parse to determine string match before resending the command string to the appropriate module. Though adequate for some RS-232 and other serial link bandwidths, this overhead time can severely impact total test system throughput. This is especially true compared to secondary addressing, which uses hardware decoding to immediately identify the recipient of the message.

An embedded controller can send these ASCII messages directly to the message-based instrument over the VXIbus backplane using VXIbus logical addresses as its addressing scheme. Contrary to popular belief, there is little or no performance gain when programming a message-based instrument from an embedded controller instead of an IEEE-488-to-VXIbus module. This is true because ASCII message interpretation time, not the IEEE-488 bandwidth, is the major communication bottleneck. Often, message-based communication is still acceptable, particularly for instruments where the measurement time dominates the ASCII interpretation time. Direct register-level communication from an embedded computer is then used for those measurements and applications that demand greater throughput than IEEE-488.

Summary

The benefits of VXIbus beyond the obvious downsizing advantage are numerous. The high-speed backplane and direct register access provide an environment for greater system throughput. Yet the user has the choice of throughput and the convenience of ASCII programming with intelligent message-based modules. The fully multi-vendor open architecture guarantees a large selection of instrument capabilities on various card sizes that virtually ensures that the system can be scaled to meet the performance and cost requirements of the application, while easing the job of integration. This also means a better lifetime support when a manufacturer obsoletes a VXIbus product. Other benefits of VXIbus include the ability to quickly reconfigure test systems to test a changing product mix. It also provides an ideal environment for the user to develop a custom module for a special purpose in the test system, knowing that it will be supported on this open architecture environment for many years to come. For these reasons, VXIbus has become a dominant architecture in the test systems of the 1990s and into the new millennium.

VXI is the key hardware technology impacting test systems of the future. Within our VXI system offering, Agilent Technologies has focused on providing two key benefits—Ease of Integration and Speed of Execution. Delivering on these benefits involves a careful balance of instrument hardware, firmware, software, and computer hardware.

VXIplug&play Tutorial

VXIplug&play is a term used to indicate conformance to new system-level standards produced by the VXIplug&play Systems Alliance. Agilent Technologies (formerly Hewlett-Packard) joined the VXIplug&play Alliance in 1994 in support of the Alliance's charter: "improve the effectiveness of VXI-based solutions by increasing ease-of-use and improving the interoperability of multivendor VXI systems." The goal of the Alliance is to achieve interoperability of mainframes, computers, instruments, and software through open, multivendor standards and practices.

The VXIplug&play Alliance has made major progress toward this goal by endorsing existing standards and defining and implementing new standards for hardware and software. As a result, the Alliance has defined complete system frameworks for vendors to improve ease-of-use and interoperability. VXIplug&play-compliant instruments include instrument drivers that take care of the low-level details of I/O communication.

VXIplug&play Frameworks

A framework, as defined by the Alliance, is related to a particular operating system (e.g., Windows 3.1/95/98/Me/NT/2000, HP-UX, and others), and specifies the requirements for instruments, controllers, interfaces, mainframes, and software packages that comply with that particular set of requirements. VXIplug&play vendors specify which framework(s) each of their products will support.

VISA I/O Library makes it possible

A standard I/O library called VISA (Virtual Instrument Software Architecture) provides a single multivendor foundation for instrumentation software. It offers an easy-to-use set of I/O control functions very similar to existing I/O libraries, and it provides a migration path for the existing installed base of VXI users. The VISA I/O Library makes the link to the VXI instrument when you use VXIplug&play function calls in your application program.

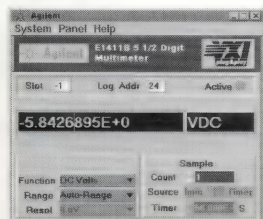
VXIplug&play Offers...

Compatibility

Maximize software/hardware compatibility in the multivendor environment.

Productivity

Use soft front panels to operate and evaluate instrument operation within minutes.



Portability

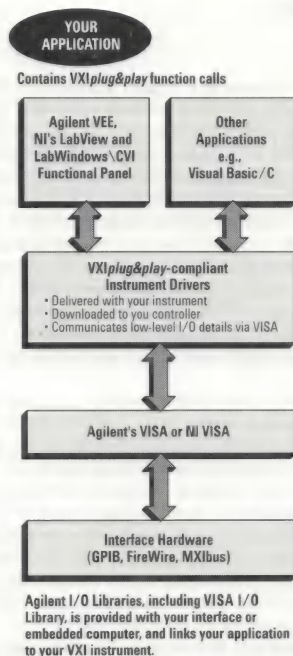
Communicate with instruments via any controller/computer interface supported by the VISA I/O library.

Interoperability

Develop application programs that are portable across computer platforms and I/O interfaces. Add new programs without having to rewrite existing programs.

How does VXIplug&play work?

Together, VXIplug&play-compliant drivers and the VISA I/O Library enable you to obtain the best instrument for your test system needs without worrying about one complete vendor solution. The code needed to make it happen is invisible to you!



VXIplug&play Requirements

VXIplug&play Alliance ensures compatibility by addressing specifications and standards. Once the Alliance defined the frameworks based on the operating system, other standards were defined. VXIplug&play specifies that drivers must include:

- C Function library files: uses the VISA I/O library for all I/O functions.
- Interactive soft front panel: provides an interactive, mouse-driven graphical interface to control and display results.
- Help files: provides programming examples, all help for instrument, C function library, and soft front panel.

Additionally, VXIplug&play-compliant drivers support the most popular test languages (Application Development Environments or ADEs): Agilent VEE, Microsoft and Borland C/C++, Microsoft Visual Basic, and National Instruments LabWindows/CVI, LabVIEW.

Agilent Technologies' Commitment to VXIplug&play

Agilent is an active leader in the VXIplug&play Alliance and the Test and Measurement industry. Agilent offers one of the most complete lines of VXI products available. Agilent continues to develop VXI products that deliver ease-of-use in accordance with the VXIplug&play standards.

Agilent VEE: Test & Measurement's Highest Productivity Language

Agilent VEE supports the VXIplug&play Windows 3.1/95/98/Me/NT/2000, and HP-UX frameworks and will support other vendors' drivers as they become available. Agilent VEE currently runs the 450+ Agilent VEE instrument drivers, also known as instrument panels, that were designed prior to VXIplug&play. Agilent VEE will continue to support the classic instrument drivers as well as the new VXIplug&play drivers.

Non-VXI Instruments: Compatible with VXIplug&play

Agilent Technologies has adapted the VXIplug&play driver technology to its GPIB system of instrumentation (non-VXI products), as well as its VXI products. Most current GPIB instruments will work in the VXIplug&play environment by using SCPI commands with either the VISA I/O library or the Agilent Standard Instrument Control Library (SICL). Agilent offers a CD ROM that contains drivers for all Agilent VXIplug&play compatible instruments. An Agilent Technologies World Wide Web server (URL: http://www.agilent.com/find/inst_drivers) is available to allow customers to download the latest version of a driver.

Environmental Specifications

These specifications apply to all Agilent Technologies VXI products listed in this catalog unless otherwise indicated on the specific product page.

Environmental	
Operating humidity:	Up to 65% relative humidity from 0 to 40° C
Storage humidity:	Up to 65% relative humidity from 0 to 55° C. Extended storage (several weeks) at humidity and temperature levels outside of this range may require recalibration. Maximum storage humidity level is 95% RH non-condensing.
Operating temperature:	0 to 55° C
Storage temperature:	-40 to +75° C

EMC, RFI, and Safety

Safety:

UL 1244 or UL 3111-1
CSA 556B or 231 or 1010.1
IEC 61010-1

EMC:

Standard	Limit
IEC 61326-1, Edition 1.2 : 2000-11 (Edition 1:1997 consolidated with amendments 1:1998 and 2:2000)	
CISPR 11:1990 / EN 55011:1991	Group 1 Class A
IEC 61000-4-2:1995 + A1:1998 / EN 61000-4-2:1995	4kV CD, 8kV AD
IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80-1000 MHz
IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5kV signal lines, 1kV power lines
IEC 61000-4-5:1995 / EN 61000-4-5:1995	0.5 kV line-line, 1 kV line-ground
IEC 61000-4-6:1996 / EN 61000-4-6:1996	3V, 0.15-80 MHz 1 cycle, 100%
IEC 61000-4-11:1994 / EN 61000-4-11:1994	Dips: 30% 10ms; 60% 100ms Interrupt > 95% @ 5000ms

Canada: ICES-001:1998

Australia/New Zealand: AS/NZS 2064.1

Supplementary information: Agilent VXI products comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the "CE" marking accordingly.

VXI Testing Environments

Altitude:

Altitude may affect products that include the features listed below:

- Any supply voltage with transient overvoltages exceeding 500 volts peak.
- Sealed relays, crystals or pressure-sensitive components which require a seal to maintain close accuracy.
- Convection cooling that may be marginal.
- Vacuum technologies.

Operating altitude for electrical isolation purposes is up to 2000 meters unless otherwise indicated. For operation at altitude greater than 2000 meters, contact your Agilent Sales Representative for assistance in obtaining more information.

Vibration

Operation, functional:

The purpose of this test is to ensure the bare product will meet performance specifications while operating under anticipated vibration levels.

Random:

0.0001 g²/Hz, 5-500 Hz, ~0.21 G rms, 10 min/axis

Survival:

The purpose of this test is to ensure the bare product will survive, damage-free, the vibration levels anticipated during transportation. The product is not required to meet performance specifications during the test.

Swept sine:

5-500 Hz resonant search, 1 Octave/min sweep rate, 5 min dwell at resonance with 0.5 G input

Random:

0.015 g²/Hz, 5-500 Hz, ~2.09 G rms, 10 min/axis

Shock

End use, handling:

Less than 45.5 kg: Half sine waveform, <3 ms duration, velocity change depending on weight

Greater than 45.5 kg: 10.2 cm free fall tilt drop

Transportation:

Trapezoidal waveform, velocity change dependent on weight, minimum acceleration 30 g

Warranty

A. Policy Statement

Agilent products are warranted against defects in materials and workmanship. The warranty period for each product will be provided at the time of sale or specified in documentation supplied with the product. During the warranty period, Agilent will, at its option, either repair or replace products which prove to be defective.

Agilent software and firmware products which are designated by Agilent for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship. If Agilent receives notice of such defects during the warranty period, Agilent shall repair or replace software media and firmware which do not execute their programming instructions due to such defects. Agilent does not warranty that the operation of the software or firmware shall be uninterrupted or error free.

If Agilent is unable, within a reasonable time, to repair or replace any product to a condition as warranted, the customer shall be entitled to a refund of the purchase price upon return of the product to Agilent.

B. Duration and Commencement of the Warranty Period

Within Agilent service travel areas, Agilent Products and certain other Products designated by Agilent sold with On-Site warranty and installation coverage will be installed by Agilent at the Customer's facility at no charge. Outside Agilent service travel areas, warranty and installation services will be performed at Customer's facility only upon Agilent's prior agreement; Customer will pay Agilent's travel expenses and other applicable expenses for such services.

Products with On-Site warranty will receive warranty services only at the initial installation site. If Products eligible for On-Site warranty and installation services are moved from the initial installation site, the warranty services will be provided only if the Customer purchases additional inspection or installation services at the new site.

All Products purchased will include a global warranty. A global warranty means that the Product will include the warranty for the country of purchase and the destination country's standard warranty in any country where the Product is moved, provided that:

- (i) the Product has a return-to-Agilent warranty, or
- (ii) if Product has an On-Site warranty, Agilent has a Product-specific support presence in that country.

Products with return-to-Agilent warranty purchased at Agilent's International Prices, battery-powered Products, Products with global warranty coverage may be returned to the closest Agilent authorized repair center worldwide. All other Products with return-to-Agilent warranty must be returned to an Agilent authorized repair center within the country of original purchase. Except for Products returned to Customer from another country, Agilent will pay for return of Products to Customer.

C. Limitation of Warranty

1. The foregoing warranty shall not apply to defects resulting from:
2. Improper or inadequate maintenance by the customer.
3. Customer-supplied software or interfacing.
4. Unauthorized modification or misuse.
5. Operation outside of the environmental specifications for the product.
6. Improper site preparation and maintenance.

THE WARRANTY SET FORTH ABOVE IS EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. AGILENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

D. Limitation of Remedies and Liability

THE REMEDIES PROVIDED HEREIN ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL AGILENT BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFIT) WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.

The foregoing limitation of liability shall not apply in the event that any Agilent product sold hereunder is determined by a court of competent jurisdiction to be defective and to have directly caused bodily injury, death or property damage; provided, that in no event shall Agilent's liability for property damage exceed the greater of \$50,000 or the purchase price of the specified product that caused such damage.

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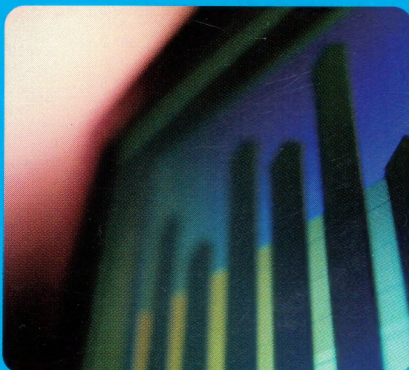
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